SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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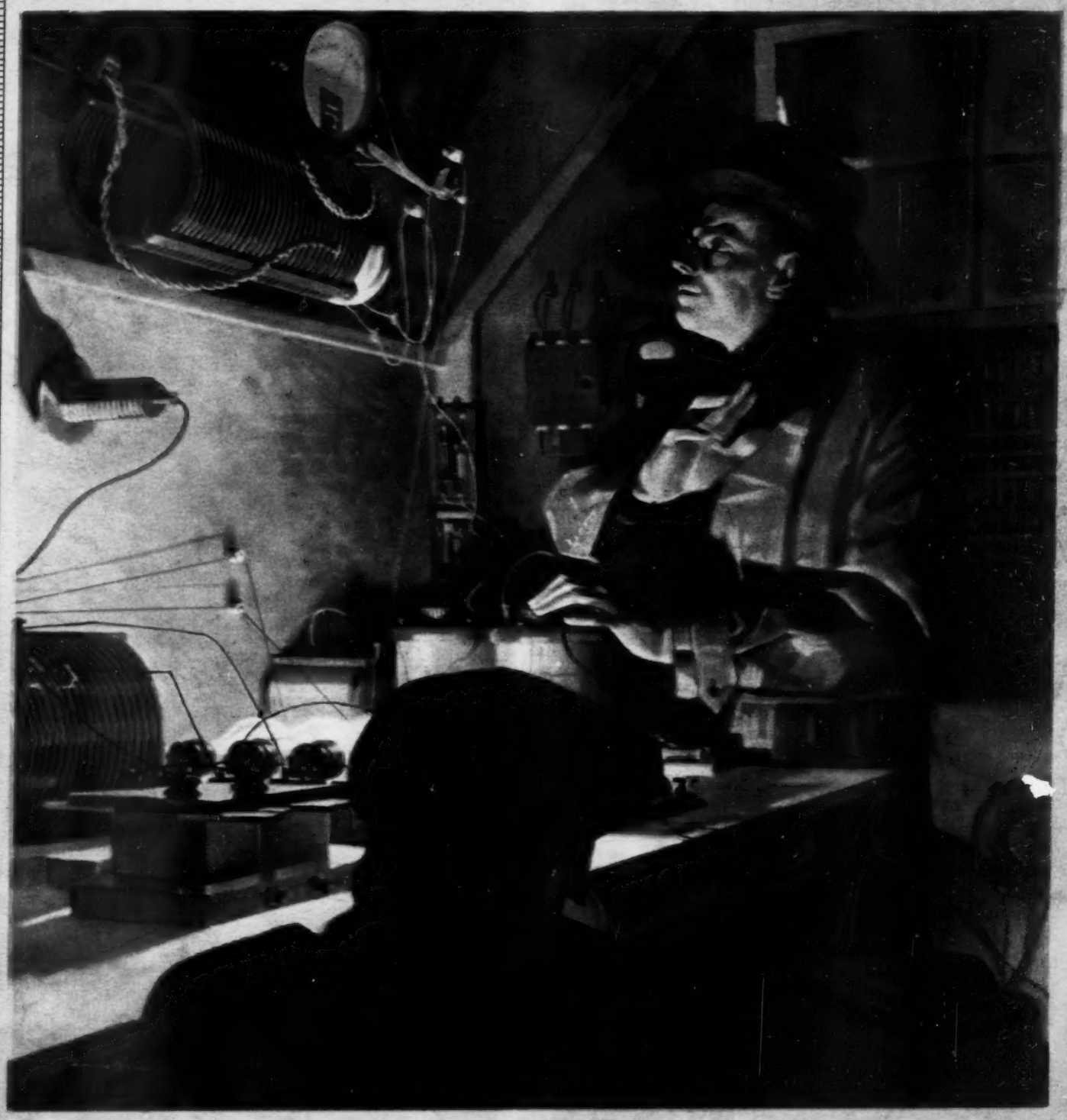

AN INCIDENT DURING THE RECENT AMATEUR RADIO TRANSATLANTIC TRANSMISSION TESTS.—[See page 232]

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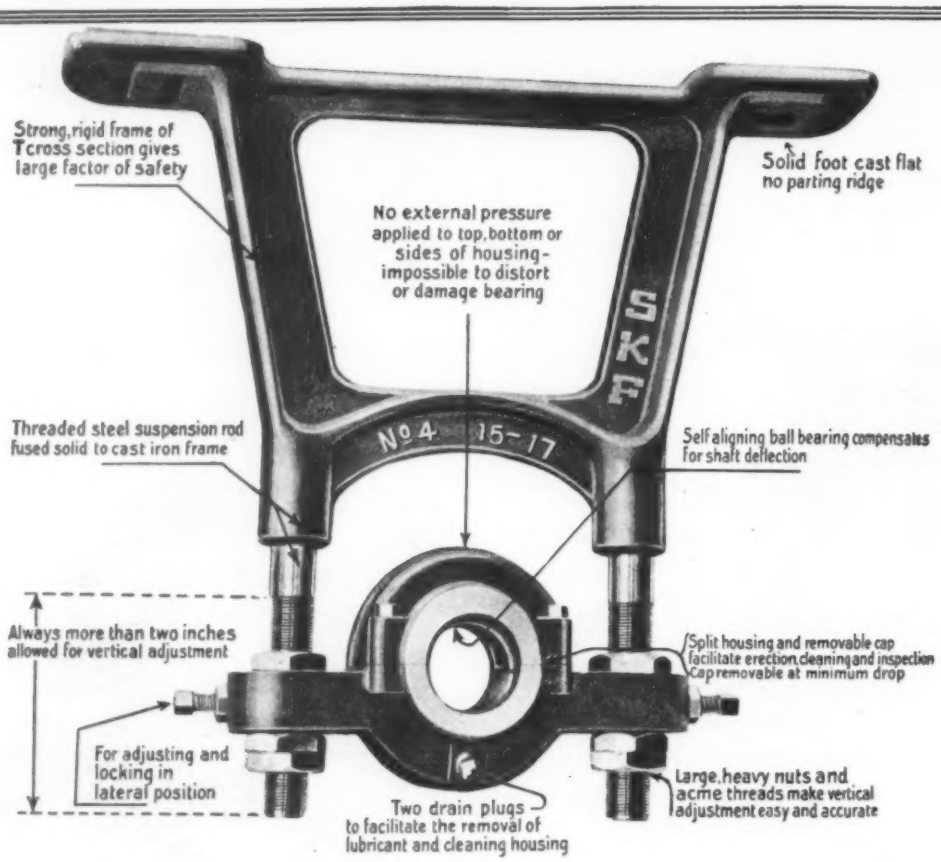

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With the Editors

FIRST of all; a few words about our cover painting. The general theme is radio—that subject so much in the public eye at the present moment. The particular theme is the amateur radio transatlantic tests, conducted during last December by several young men who set up and operated a transmitting station on the outskirts of Greenwich, Conn. Their station was housed in a small portable building, heated by an oil stove; obviously these conditions, considering the intense cold of the mid-winter nights, were hardly conducive to warmth and real comfort. Yet these young men spent night after night adjusting their transmitting equipment and sending out their coded messages in the hope that they might be picked up by the representative of their radio fraternity located in Scotland for the duration of the tests. They deserved to succeed—and they did; with less than one kilowatt of energy, the 1BCG station spanned the intervening 3200 miles of land and ocean. Our cover depicts an incident during the sending tests at this little station.

THE terrible catastrophe which has befallen the Army semi-dirigible "Roma" was hardly to be thought of in advance. Somehow or other, we have come to look upon the rigid type, as represented by the Zeppelin, with suspicion, for there have been so many accidents with this class of aircraft that almost instinctively we look for more of them. The semi-rigid and non-rigid machines, however, have enjoyed a less disastrous career; these closely allied types have inspired some degree of faith in most of us, in and out of aeronautical circles. The smaller dimensions of the semi-rigid and non-rigid airships, too, have made for a minimum of accidents; and when such accidents have occurred, they have not assumed the proportions of a catastrophe. So in this issue, in a form that has already gone to press as these lines are written, there is a description of the "Roma" and her trial flights. It remains for us to tell the story of the "Roma" disaster in the May issue. Better still, we are going to tell the story of helium gas—that non-inflammable substitute for hydrogen—which is again in the public eye. Progress of real value has been made here, and we pride ourselves in having the latest facts.

WHEN word came from Kitty Hawk, N. C., to the effect that two brothers, the Wrights, had made a successful flight in an engine-driven flying machine, everyone was skeptical. Who wouldn't be, at that time, when virtually little had been accomplished in the way of flight even with the cumbersome lighter-than-air machines? Yet the word was the truth: the Wrights had made a flight in a power-driven machine. And history is forever repeating itself. Not so long ago word came out of Germany, telling of the wonderful soaring flights of German aeronautical experimenters. One experimenter was said to have made a flight of 21 minutes and 37 seconds in all directions, rising to a height of 200 feet and landing close by and but 40 feet lower than the starting point. A difficult story to believe—quite on a par with the rumor of the Wright brothers' first flight! So we waited until the photographs began to arrive and until we could receive exact data from Germany. Then we turned this material over to Mr. L. d'Orcy, a recognized authority and writer on aeronautical subjects and one who, at first hand, has seen aviation develop from the first meet held at Rheims, France, to the present day. Mr. d'Orcy tells the story of the soaring birdmen in this issue, and he assures us that it marks the beginning of a new era in aviation.

NOW and again it is our good fortune to be prophets. Sometimes our prophecies come true only after the lapse of many years; sometimes we have but a short wait. Thus in our March issue we had something to say regarding the excessive weight of railroad coaches, and we predicted that railroads would soon have to resort to lighter trains. The limit of weight has been reached—surpassed, in fact, and progress must now be made toward reduction of weight. While we were writing those prophetic lines, an experiment in weight reduction was going on in England. A radical change in the arrangement of wheels and trucks on passenger coaches has brought about the articulated train—the entire train becomes a single unit, instead of being assembled of separate coaches. We present an account of the articulated train in this issue, feeling that it points the way to a reduction of weight in American rolling stock.

ELECTRIC lamps have come in for their share of publicity. Recent investigations in New York City have disclosed some interesting facts regarding the cost of making electric lamps as contrasted with the selling price; and while it is distinctly out of our province to discuss the commercial end of lamp manufacture, it is our work to tell about the manufacturing processes. There is a real story behind each electric light: its production calls for the most intricate machinery—machinery that fashions glass into all kinds of shapes with the skill of the most experienced glass-blower, and that assembles delicate parts with a dexterity not even approached by the human hand. Heretofore the facts regarding lamp production have been more or less secret, but we have finally succeeded in obtaining the latest data which is presented elsewhere in this issue.

INTEREST in Dr. Carrington's article of January, "The Mechanism of the Psychic," has been fully up to expectations. We do not recall that any single story has ever resulted in the necessity for our forwarding so many letters to the contributor. The discussion which Dr. Carrington has thus ably opened will be continued by at least two more articles in early issues. One of the staff will discuss the psychic manifestations—we have explained already the sense in which we use the term, and shall not further apologize for it—which pertain more strictly to the *mind*. He will show one way in which these can be explained without the introduction of any supernatural element; and he will insist that these assumptions be disposed of, for or against—proved possible or disproved—before other and less happy explanations come into consideration. And Dr. Carrington will carry his story further, giving similarly an account of several of the more outstanding *physical* effects which have been produced without visible agency; showing likewise the most plausible of the explanations which have been put forward to account for these; and making a few suggestions for further attack upon the problem of psychic research. We believe that the general impression created by these two articles will be that, difficult and tenuous as this subject is, we are really coming to an understanding of it that compares favorably with that possessed, in their field, by the very earliest pioneers in electricity.

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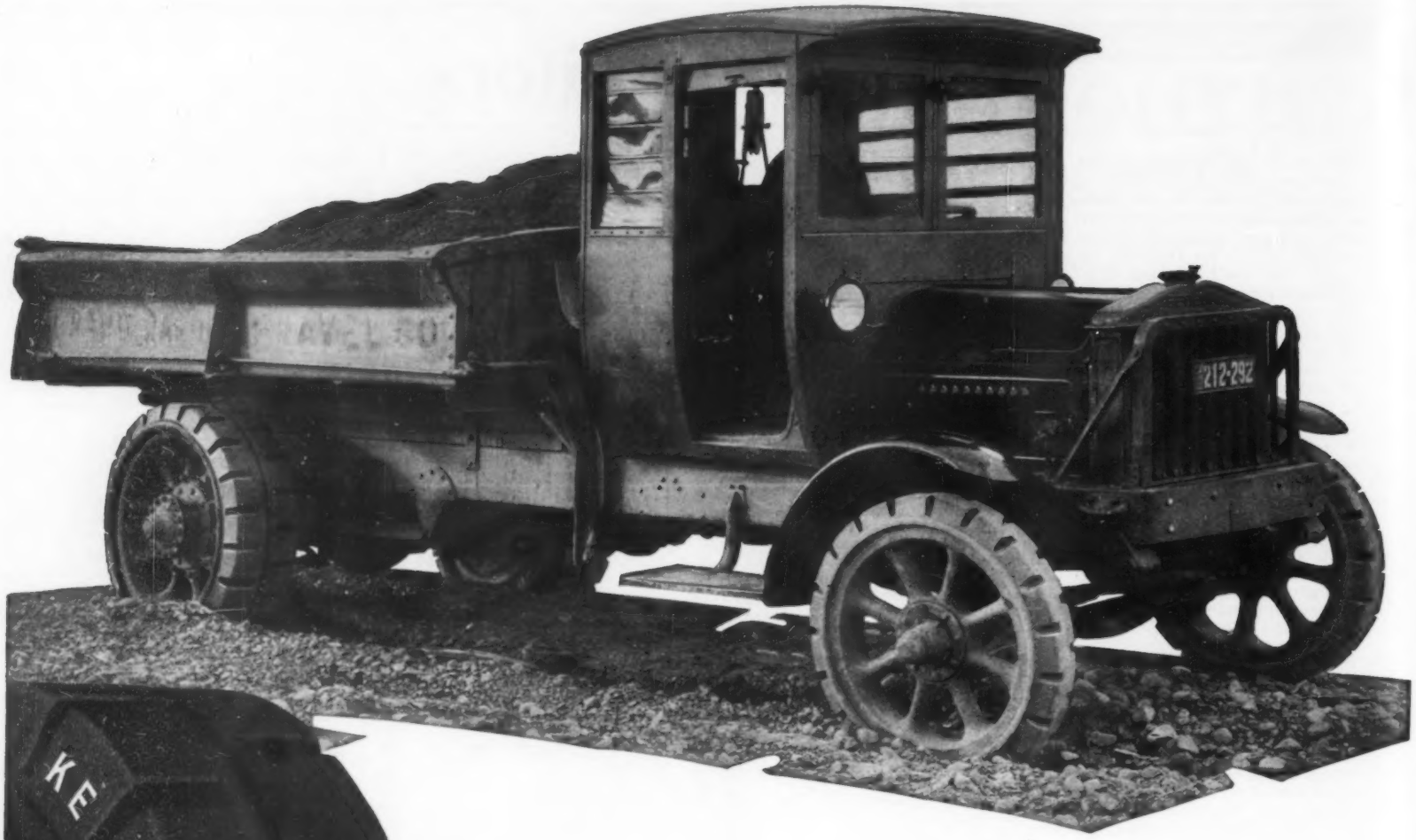

Caterpillars were specified in preference to pneumatics

When the Grand Rapids Gravel Co. of Grand Rapids, Mich., purchased the truck pictured above they could have had pneumatic tires but they specified Caterpillars instead.

This truck is used in hauling sand and gravel direct from the pit and, as the picture clearly shows, the road conditions demand tires that are able not only to get traction but to stand severe punishment as well.

Pneumatics might have given the necessary traction but their inability to stand punishment would have made their use very expensive on this truck. Caterpillars, however, give as much traction as properly inflated pneumatics and are also longer-lived and more dependable.

It is this combination of traction, dependability and mileage with low cost per mile which invariably leads the careful truck tire buyer to equip his trucks with Caterpillars.

Caterpillars are made in sizes suitable for trucks of every type and weight

Kelly-Springfield Tire Co.

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SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, APRIL, 1922

Agriculture	Manufacturing	Transportation	Trade	Professional	Domestic and personal	Clerical
1,084,000	1,931,000	214,000	670,000	1,016,000	2,184,000	1,424,000
12.7%	22.6%	2.5%	7.8%	11.9%	25.5%	16.7%

How our female workers are distributed over the several broad classifications into which the Census Bureau groups them. The 0.3 per cent unaccounted for are engaged in mining and public service, but in such small numbers that they cannot be satisfactorily shown on the same scale with the groups above represented. The "Domestic and Personal" group includes only hired workers, and not home-keeping wives and mothers, who are officially listed as without occupation

Agriculture	Mining	Manufacture	Transportation	Trade	Professional	Domestic and personal	Clerical
9,867,000	1,087,000	10,882,000	2,852,000	3,574,000	1,136,000	1,216,000	1,696,000
29.9%	3.3%	32.9%	8.6%	10.8%	3.4%	3.7%	5.1%

The way in which the male workers are distributed over the same groups. The public service workers, 2.3 per cent of the total, are again not represented. As might have been expected, the men and the women are allocated in entirely different proportions to most of the groups. The most significant feature of the showing here made is the size of the "Manufacture" group, and the fact that less than one-third of the male workers are able to produce food for all of us

HOW AMERICA'S MALE AND FEMALE WORKERS EARN THEIR DAILY BREAD

A radish from Chinese seed

World Crops for America

How Modern Science Combs the World for New Things to Eat, Picking and Choosing for the Menu of the Future

By R. P. Crawford

Another vegetable giant from the Orient—udo, a Japanese product resembling asparagus

WHAT shall we eat a hundred years from now? Will it still be the conventional beefsteak and potatoes or shall we have entirely different appetites? What will our farms grow? Will it be corn and wheat or shall we be planting new crops of which America knows nothing today?

The civilized world did not always eat potatoes and many people only a few years ago regarded tomatoes—"love-apples," they called them—as poisonous. We are continually changing and developing our appetites and what we regard as a weed today we may eat tomorrow.

It must also be remembered that certain areas of our country are amazingly similar to areas in far-off lands. What grows successfully in other countries may be grown successfully in America under the same conditions. One part of our country may be undeveloped because apparently nothing can be grown there profitably, but in a remote corner of the globe may be people living under exactly the same conditions.

There is today in the United States one organization whose sole work consists in finding new foods for America. It is the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture. Although it has had little recognition and few people know of its existence, its influence, its correspondence and its explorers touch the far-off corners of the globe where white men seldom tread. It is one of the most romantic of government bureaus. Its explorers, whose sole duty is to discover new plants for America, travel from the heart of Africa to the innermost recesses of China. Its record of achievement is written in deeds quite as full of interest and as thrilling as more openly dangerous exploits. When this office celebrates in 1922 the twenty-fifth anniversary of its establishment, it will have imported more than 50,000 different plants and seeds to be tried out in this country.

Consider the date palm, as an example of one of its accomplishments. Dates are now being grown successfully in California and the Southwest, and the nucleus of a successful American industry is being formed. There are now about a million date palms around Indio, California. Experimental date orchards were established at Mecca and Indio, Cal., more than 15 years ago, and a large number of the best Old-World varieties of dates have been tried out.

There is long-staple cotton, which has become such a success in Arizona and neighboring States. This was imported from Egypt. "There is nothing comparable to the development of the long-staple cotton industry unless it be the achievement of these East Indian magicians, and behold, a tree grows before one's eyes," is the way one expert put it. The first plantings were made around Phoenix in 1900. For 12 months or so the experiments with this Egyptian cotton were carried on until it was felt that it could be grown on a commercial basis. The first year about 400 acres of commercial cotton were planted. A few years later the cotton crop of the Salt River Valley for one year would have paid the cost of two reclamation systems such as now supply it. Long-staple cotton is used in making automobile tires, mercerized goods, and some of the finer knit goods.

The Department of Agriculture spent $200,000 introducing a rice and establishing an industry in California worth in one year $20,000,000. Then there is durum wheat introduced from Russia. Land in the Northwest that formerly would not grow crops now produces from 20 to 45 million bushels of wheat. The Department of Agriculture introduced the naval orange from Brazil and a single year's output in California amounted to 13,000,000 boxes.

In the Southwest and many parts of the plains States corn can not be grown. The world was searched for suitable crops and the result was that the grain and forage sorghums were introduced. Sudan grass, introduced from Africa only back in 1909, has now become a very popular crop in the Southern States and is growing in favor throughout the Middle West. Peruvian alfalfa was introduced from Peru in 1899. It has been especially popular and suited to the southwestern and western coast of the United States. It starts growth earlier in the spring and continues later in the fall, with consequently more cuttings per season.

These instances are perhaps enough to convince one of some of the things that have been accomplished for American agriculture by matching conditions in the United States with conditions in other countries where certain crops are being raised successfully. Of course not all of these crops were developed entirely through the Office of Foreign Seed and Plant Introduction, because they are matters requiring the cooperation of different lines of agriculture and of individual farmers.

Before any new plant immigrants are permitted to enter the United States they must go through Ellis Island. Not, however, the Ellis Island of the Russian and Polish immigrant, for the plant importations have their own Ellis Island. These field workshops and laboratories of the Office of Foreign Seed and Plant Introduction are located in Washington, D. C.; Miami and Brooksville, Florida; Bell (near Glendale), Maryland; Bellingham, Washington; Savannah, Georgia, and Chico, California. As soon as the new plant immigrant arrives in this country it must go to one of these stations to be officially inspected to see if it is a desirable citizen. Some of the plants, like people, have diseases which if they ever gained a foothold in this country would prove disastrous. If they pass the examination, the seeds or cuttings are next planted at one of the stations. In a short time seeds or plants are ready for distribution to farmers and nurserymen who it is known are in a position to care for them. As the seeds and new plants become more plentiful from year to year the distribution is made on a wider scale, and finally practically anyone who desires some of the new plants is given a few. Those receiving the plants or seeds are expected to make reports as to their progress.

The station at Brooksville, Florida, was established to match the conditions in the moister but not tropical portions of China and Japan. The Chico station in California, because of its abundance of irrigation water, its high summer temperature, long growing season and mild winters, makes possible the trying out of widely varying crops. The Bellingham, Washington, station has to do especially with experiments with flowering bulbs. The station in Washington, D. C., is where most of the disease inspection work is carried on, as well as many laboratory experiments of a miscellaneous character.

Jujube fruits grown at Chico, Cal. When candied they taste much like dates. It is indigenous in southern Europe and throughout tropical and temperate Asia

There are few things more romantic than the work of an agricultural explorer. Most explorers deal more or less with the evident things in a country. The agricultural explorer deals with things that to an ordinary person would be almost invisible. He must travel to the out-of-the-way places and study individual plants. The ordinary explorer would give them only passing notice. To be a successful explorer one should also have a wide knowledge of agricultural conditions at home so as to be able to know a "find" when he sees it.

Probably few have done as much for agricultural exploration as has Barbour Lathrop, who was awarded some time ago the first of the Meyer Memorial Medals. Mr. Lathrop is a private citizen who has conducted numerous expeditions in search of rare plants the world over at his own expense. Often he has taken representatives of the Department of Agriculture on these excursions and paid all the cost of the journey. Mr. Lathrop first took David Fairchild, now the head of the Office of Foreign Seed and Plant Introduction, with him. On this trip he and Mr. Fairchild concluded that the work should be done in a big way. A plan was suggested to Secretary James Wilson of the Department of Agriculture, and he ordered it put into effect.

Mr. Lathrop and Mr. Fairchild made a three-year agricultural exploration, visiting every continent and one-half of the countries of the world. It was on this excursion that the long-staple cotton, mentioned above, was introduced to America. This trip also marked the foundation of a real workable department, devoted to this line of work. That was some 20 years ago; and Mr. Lathrop still continues his journeys, taking experts with him at various times. Some time ago he purchased a private bamboo grove near Savannah, Georgia, and presented it to the Department of Agriculture on a 99-year lease.

One of the famous explorers of the Department of Agriculture was Frank N. Meyer, who at his death a few years ago left the money establishing the Meyer Memorial Medal to be awarded to agricultural explorers. Mr. Meyer specialized in China; he had walked 10,000 miles through the heart of that country, Manchuria, Korea, and parts of Tibet and Russian Turkestan, looking for plants that might be of value in America. As David Fairchild once so aptly said of him:

"His hardy yellow rose peers in upon me through my study window, and up in the border his scarlet lily is in bud, while the perfume of his lilac has barely passed away. His white-barked pine is dusting its pollen into the air, his Euonymous and his hardy bamboo are growing at the corners of the house, and his dry-land elm with its delicate branches shades the entrance. So much of China has he successfully transplanted to this country."

It is said that Meyer could keep in mind thousands of plants—even if he had seen them only once—and recognize almost instantly any that were strangers to him. He collected wild alfalfas in the Caucasus, Chinese Turkestan and Siberia; sorghums and Chinese pears in Manchuria; wild peaches and almonds in the Kansu Province; chestnuts east of Pekin; persimmons in the Ming Tombs Valley; wild conifers in the Wu Tai Shan; citrus fruits on the Upper Yangtze; bamboos and strawberry trees (the Yang mae) south of Shanghai; jujubes and the pound peach in the Shantung Province; dwarf almonds, dwarf cherries and apricots, and large fruited oleasters in Russian Turkestan; desert poplars and tamarisks, wheats and barleys in the desert region of Chinese Turkestan; wild apples and apricots in the Tisu Shan range which divides Siberia and Chinese Turkestan; and large fruited currants from the Yakutsk Province of Siberia.

The life of an agricultural explorer is not an easy one. Mr. Meyer was once attacked by ruffians in Harbin and one time stood up against a wall to be shot, but he managed to talk himself out of the uncomfortable situation.

It was only a few months ago that H. L. Shantz, another of the explorers of the department, returned from a 12 months' tour in Africa. Mr. Shantz traveled from Cape Town to Egypt, and, all told, journeyed about 10,000 miles over the dark continent. However, he did not find it as dark as it has sometimes been pictured, and declared that most of the dangers of African travel have been greatly exaggerated. Mr. Shantz explored the wild jungle-country of the Upper Congo, and journeyed into the wild-animal country of British and East Africa. And yet the party was not molested by either natives or animals. Mr. Shantz brought back more than 1600 specimens of African plants which will be tried out in America. One might name many other explorers who have done great things for American agriculture, but the brief stories of these three give some idea of the life of an agricultural explorer.

The dasheen, eminently suited to the Gulf States and the Pacific coast. When cooked it is, to all intents and purposes, a potato with the flavor of a chestnut

There are scores of novel and interesting plants which are just coming into use in America as a result of the plant explorations. Take the chayote, for instance. The chayote belongs to the cucumber family, and its native home is in Mexico and Central America. Today it is grown in some of our Gulf States and in Southern California. The different varieties vary in size from a few ounces to two pounds, or even more, and the color from dark green to an ivory white. Chayotes, if stored in a cool place, may be kept for several weeks. When prepared for the table, they are fried, stuffed, pickled, or baked with cheese.

There is the Assyrian pear. This was discovered by Frank Meyer, the explorer referred to above. The Assyrian pear is resistant to fire blight, which has been the bane of many orchardists. Experiments are now being carried on with this pear in Oregon.

The Japanese udo, it is believed, will become one of our most popular vegetables. It has a unique flavor and to a large extent resembles asparagus. It makes an appearance early in the spring, and can be blanched like endive and celery. The shoots which it yields are often two feet long and an inch in diameter. It does not have to be replanted more than once in ten years. The advantage over asparagus is that the white shoots of the udo are edible to their very base.

Then there are the mangos. There are said to be more varieties of mangos than there are of peaches. There are some no larger than a crabapple, and others which weigh six pounds. These fruits form a most popular food in India. At the plant introduction garden at Miami, Florida, the Department of Agriculture now has fruiting some 20 different varieties. The unpopular reputation which the mango received some years ago was due to the inferiority of some imported varieties. The better kind of mangos are as easily eaten as cantaloupes and have a delightful odor, much like that of pineapples. It is believed that the mango will become one of the most important products of southern Florida.

The production of Oriental persimmons is just getting under way in this country. The Oriental persimmons are hardly to be confused with the common persimmons grown down South. In Japan the objectionable pucker of persimmons is removed by packing them in barrels saturated with sake, and similar processes are being worked out in America.

The bamboo is now being grown extensively in a few plantings in the southern United States. The Oriental timber bamboo is said to produce its seeds not oftener than once in 40 years, so young plants had to be brought to America and tried out. Bamboo may be used for barrel hoops, trellises, light ladders, baskets, furniture, and even for food. The giant shoots, which sometimes grow at the rate of over a foot a day, when cooked form a great vegetable delicacy.

There are the jujubes, which are also comparatively new to this country. The jujube tree, which grows to be some 40 or more years old, is well suited to a large part of America, since there appears to be no weather too hot for it, although it must not have too much moisture. The fruit of this tree has a flavor unlike that of any other fruit and when candied tastes like dates.

The Chinese petsai is lettuce's great rival, and one gardener in New Jersey has grown it for several years. It can be produced for about half the cost of lettuce and will grow almost anywhere throughout the country.

A collection of plant immigrants arriving at Washington, where everything received undergoes a rigid examination to make sure that it does not harbor disease

The dasheen has often been mentioned. It is similar to the white potato, but when cooked has the flavor of chestnuts. It may be prepared in almost any way that potatoes can, and is cooked about the same length of time. In many parts of the Pacific Coast and Gulf regions there are places where the dasheen could be grown more successfully than any other crop.

The tung-oil tree is being tried out in the Gulf Coast States and in California. From the seed of this tree is made an oil which paint manufacturers consider one of the best drying oils known to the trade. Importations of the oil each year are estimated at between $3,000,000 and $5,000,000. The trees established in America seem to be doing well.

Most people are familiar with the pistachio nuts, the little green nuts used so often in ice cream and cake. Trees bearing these nuts have been introduced from central western Asia, and it has been found that they do exceedingly well in the Sacramento and San Joaquin valleys of California.

One might go on and enumerate almost indefinitely new plants which are being developed for American farms and gardens. There is a Chinese chestnut that is resistant to bark disease; a Chinese dry-land elm that is resistant to extreme drought, neglect, and extremes of hot and cold; and a sweet cherry that ripens ten days before the earliest cherries. The avocados are also becoming a popular fruit and possess a real food value.

One should not forget the flowering bulbs which are grown in such profusion at the Bellingham gardens. The famous Dutch bulbs for which American people have been paying around $2,000,000 annually can be grown quite as well in America, it has been discovered, and, in fact, the home-grown bulbs in some respects are superior to imported stock.

The field of plant exploration is almost unlimited. In fact, its possibilities have hardly been touched. Out of the half million or so distinct plants grown on the globe, man so far has learned to use only a few hundreds. We will not necessarily continue always to grow the plants we do now. Some of them are expensive food producers, some produce foods that are difficult to digest, and some we may leave behind as we learn to like others better. The American food producer today can pick from the entire world the crops most suited to his land.

Thunderstorm-Breeding Spots and Engineering Design

AFTER discussing the probability that thunderstorms are likely to develop with more frequency in certain localities than in others, due to local conditions, Robert E. Horton, consulting engineer, Voorheesville, N. Y., suggests in the April *Monthly Weather Review* that the subject is worthy of study because of its relation to the design of engineering works. Mr. Horton notes that he has observed thunderstorms over cities, particularly Albany, N. Y., and Providence, R. I., "which originated immediately over the city and did not travel far outside their limits on days when there were no other adjacent thunderstorms." He expresses the belief that "some cities, if not indeed most inland cities of, say, 100,000 population or more, appear to be thunderstorm spots." He also points out that "a shallow lake with sandy margins located in a forest may serve as a thunderstorm breeder," and cites as proof observations made by him over Oneida Lake, N. Y. Furthermore, "Some western arroyos are notable for the frequency of occurrence of so-called cloud-burst thunderstorms . . . whereas another adjacent to it might rarely produce them." The desirability of observations to show what particular areas, rural or urban, are what Mr. Horton terms "thunderstorm-breeding spots" is urged as bearing upon the design of dams and of sewers. What Mr. Horton says in conclusion about cities breeding thunderstorms and the relation of this possibility to sewer design follows:

"An indication of the truth of the supposition that cities breed thunderstorms might be obtained by comparison of rain gages in the surrounding country with records taken in the city during the summer. Should it prove true that cities are in some instances thunderstorm breeders, whereas other nearby cities may not possess this characteristic, then such facts might have a very important bearing on various engineering problems, notably storm-sewer design, and might vitiate the utility of application of records of thunderstorm rain intensities in one city to another nearby city, even though the climate of the two places and the total rainfall per annum might be very nearly the same."

Applying the Lessons of Industry to the Theater

Ingenious Devices, Partly or Wholly New, Incorporated Into New York's Newest Play-House

GREAT improvement in theater building has been made in the past few years, largely with a view to the comfort and convenience of patrons. Methods and devices for handling scenery also have been improved and adopted by a few theaters, again with an eye to the patron, for these have been for securing clever stage effects or for shortening the wait between acts. Now comes a theater embodying all of these improvements, but designed also with the specific idea of making it easy for actors, electricians, stage hands, scene shifters and all others of the army of workers behind the footlights, to coordinate their efforts to produce a good play. Moreover, for the first time recognition is given by a theater to the fact that the quality of workmanship (in this case the play) may depend mightily upon the surroundings and environment of the workman.

The designing, especially of the stage and its equipment, has been gone about with precious little regard for precedent and tradition. Many of the old devices of the stage, which are present in nearly every stage in the country, are gone and in their stead is a collection of new devices which are so obviously good that we are forced to exclaim, "Why didn't someone think of that before?"

Our drawing shows the main features of the stage construction. The theater, from the rear of the house as far as the edge of the balcony, although elegantly appointed, does not differ appreciably from that in other new theaters. The first discrepancy we discover is the absence of the battery of spotlights usually located, with their operator, somewhere in the gallery. Instead there is a bank of floodlights so cleverly concealed in the decorations of the under rim of the balcony that the audience sees only their effect and never notes their presence.

The most striking innovation, perhaps, is the absence of boxes, which have long been a traditional feature of theaters, although a notoriously inconvenient and high-priced spot from which to view a play. In the space on either side of the stage usually occupied by the boxes there are two miniature stages, which communicate from the rear with the main stage. Their most important use is for the purpose of acknowledging applause. When the main curtain descends at the end of an act it remains down and the time usually devoted to raising and lowering it to acknowledge applause is saved. The actor or actors, meanwhile, step to the miniature side-stages into the illumination of spotlights concealed in the balcony decorations. These stages also may be used for the presentation of a prologue, or in the cast of a large spectacular production may be easily connected to the main stage as "aprons," thus extending the available stage room across the entire width of the building.

Another feature which will be quite noticeable to the audience, and quite as puzzling, will be the sudden appearance of the orchestra, apparently from nowhere. The explanation is that the orchestra pit is really a huge hydraulic elevator, which can be lowered out of sight or raised to suit the occasion. The orchestra enters through the basement, and when ready to play is suddenly lifted into view of the audience. The elevator takes the form of a crescent, supported on several hydraulic lifts. The orchestra pit can be raised even to the level of the stage and used as an extension.

The effect which seems next most remarkable to the audience, no doubt, is that in out-of-door scenes the sky, instead of being a wavering "drop" of blue cloth, seems real and quite as limitless as the heavens themselves. This is accomplished by the use of a "horizant," a device which originated in Europe, and which has been used in one or two of the small "art" theaters in this country, but never before in a commercial theater here. The back wall of the building is simply shaped of smooth cement with curved corners. It is a neutral gray, and the stage director, through his electrician, paints upon this background in light the effect he desires—be it the effect of night, of dawn, or the shimmering heat of the desert noon. A small trench is constructed just in front of the wall so that workmen and actors may pass across the stage unobserved during the progress of an act.

Mr. Earl Carroll, the designer of this theater, regards the adoption of the "horizant" as the greatest single step forward he has taken. "Playwrights have been very cautious," he said, "about writing out-of-doors scenes into their plays because of their unreality. I have experimented extensively with the horizant and I am convinced that this demonstration will cause it to be generally adopted. I think it will bring the out-of-door play, now almost entirely limited to the movies, to the speaking stage."

From the viewpoint of coordination of effort, an important change is in taking the electrician and stage manager from the "wings" and placing them at the very front and center of the stage in plain view of all of the players. They sit in a pit with their heads just above stage level, but are concealed from the audience because their heads are just below the line of vision from the topmost seats in the gallery over the footlight reflectors. From this point of vantage the director and electrician observe not only every light and every effect, as well as the actors, but through a telescopic peephole at their backs can see the entire audience and all of the house lights. Hitherto this was impossible because these two important men were located in the wings, where they had an imperfect and distorted view of the stage and no view at all of the audience and house.

The electrical arrangements alone for a large modern theater might well occupy a page of description here, but we shall have to note them briefly. The rheostats for "fading out" or "fading in" the footlights and floodlights are huge motor-driven affairs, while the great number of switches are of the remote control type and altogether occupy solidly a good-sized room. All are operated from a central control board by the chief electrician, who may have a number of assistants. In this new theater the electrician is provided with a master hand wheel to which his assistants "hook," electrically, the various apparatus he is using at a particular moment. For instance, if he is changing from the effect of dawn to daylight, the deep blue and red lights would be so connected that turning the wheel would slowly fade them out, while by the same movement the blue and white lights would fade in. Within reach of the electrician, also, are a great number of master levers by means of which he operates the switches in a room beneath the stage to secure his lighting effects, in much the same manner that the organist operates the stops on a pipe organ.

Another discarded inadequacy, small in itself but as old as the theater, is the peephole in the curtain. This has been replaced by a telescopic lens arrangement on either side of the stage, which gives an easy view of the entire audience.

The degree to which realism can be carried may be realized from the fact that the stage equipment includes a kitchen range with utensils and dishes for cooking and serving a full meal. When the lines of a play call for the serving of a meal it will be a real meal of real food, served piping hot from the kitchen in the wings.

The arrangement for handling scenery and drops also is noteworthy. The large pieces need no longer be pushed about by "main strength and awkwardness," but instead are whisked aloft by counterbalanced cables and secured there by a few men stationed on a platform some 60 feet above the stage. The counterbalances are buckets filled with buckshot, which may be emptied or filled to the proper weight. Thus a few men are able to perform the work that once required the services of a large number of scene-shifters. This system is coming into gradual use, but for the first time the theater designer has realized that it makes unnecessary the two wing balconies on each side of the stage, which are standard to theater construction. Once useful for raising and lowering drops by hand, these balconies lately have been not only useless but collectors of dust and junk.

One of the obvious improvements is a simple lift system for handling the trunks of performers with a minimum of effort. Of the scores of theaters in New York, it is said this is the only one where the moving of trunks does not involve the back-breaking expedient of climbing stairs.

The arrangement of dressing rooms for the players also marks a distinct step away from tradition. It has long been the custom to have two or three dressing rooms on the same floor with the stage for the use of the stars. These sometimes were elegantly appointed. The rest of the cast, however, had to climb stairs to stuffy dressing rooms with little or no regard for comfort and convenience. The space on the stage level of any theater is always precious, and that which might have been given to the stars' dressing rooms has been given over to a "green room," for the use of the whole cast and their guests. The room is a cozy one, artistically decorated, and with a mammoth fireplace at one end. It is expected that this room will not only serve innumerable social purposes for the players, but will be the scene of gatherings of notables, the reading of plays, and the like.

From the green room a marble staircase winds to the dressing rooms above. Something of the peculiar psychology of players has been taken into account in building the staircase, for half-way up one is confronted with a very cheerful "good-luck" statuette.

The theatrical world of New York never tires telling of the architect who, with his head in the clouds, undertook the construction of the ideal theater. All sorts of expensive and new-fangled things were introduced into the plans looking to the comfort of the audience and the better presentation of the play. But just in the nick of time, before actual work on the theater itself had begun, some practical-minded person got his eye on the plans and called the attention of the architect to the fact that he had omitted to provide a single dressing room of any description. Mr. Carroll has not repeated this error.

The players, in their dressing rooms, are given the same conveniences and service that they might expect in a great hotel. The rooms are fitted with shower baths and are elegantly outfitted and equipped. Excepting that the rooms for the stars are directly at the head of the stairs, there is no distinction between the treatment of star and chorus girl. The women's dressing rooms open into a common reception room, where they may receive guests, and which is fitted with an excellent library and lounging couches.

All of these improvements have involved the spending of thousands of dollars on the construction of the theater which might have been saved by ordinary construction. Many of them never are seen by the audience, and old-time theatrical men will contend, no doubt, that they contribute nothing to the value of a play, which after all marks it for success or failure.

Mr. Carroll has spent large sums on improvements of this nature with the idea that they will make it easier to coordinate all of the myriad activities back of the footlights; that this will contribute directly to the success of any theatrical production staged there, and therefore to the financial success of the theater itself. "If this be idealism," says Mr. Carroll, "certainly it is a very practical sort."

Furthermore, the democratic treatment accorded the players is in direct line with a marked tendency in the theatrical world toward the labor conditions which obtain in industry. Most actors now belong to one of two organizations conducted along the lines of the labor unions. As a rule, conveniences for industrial workers in their leisure moments have not been carried to the extreme attempted in this theater, but similar methods applied to industry have paid definite profits. They enhance the interest of the worker in the enterprise and spur him or her to better effort at the machine—or before an audience.

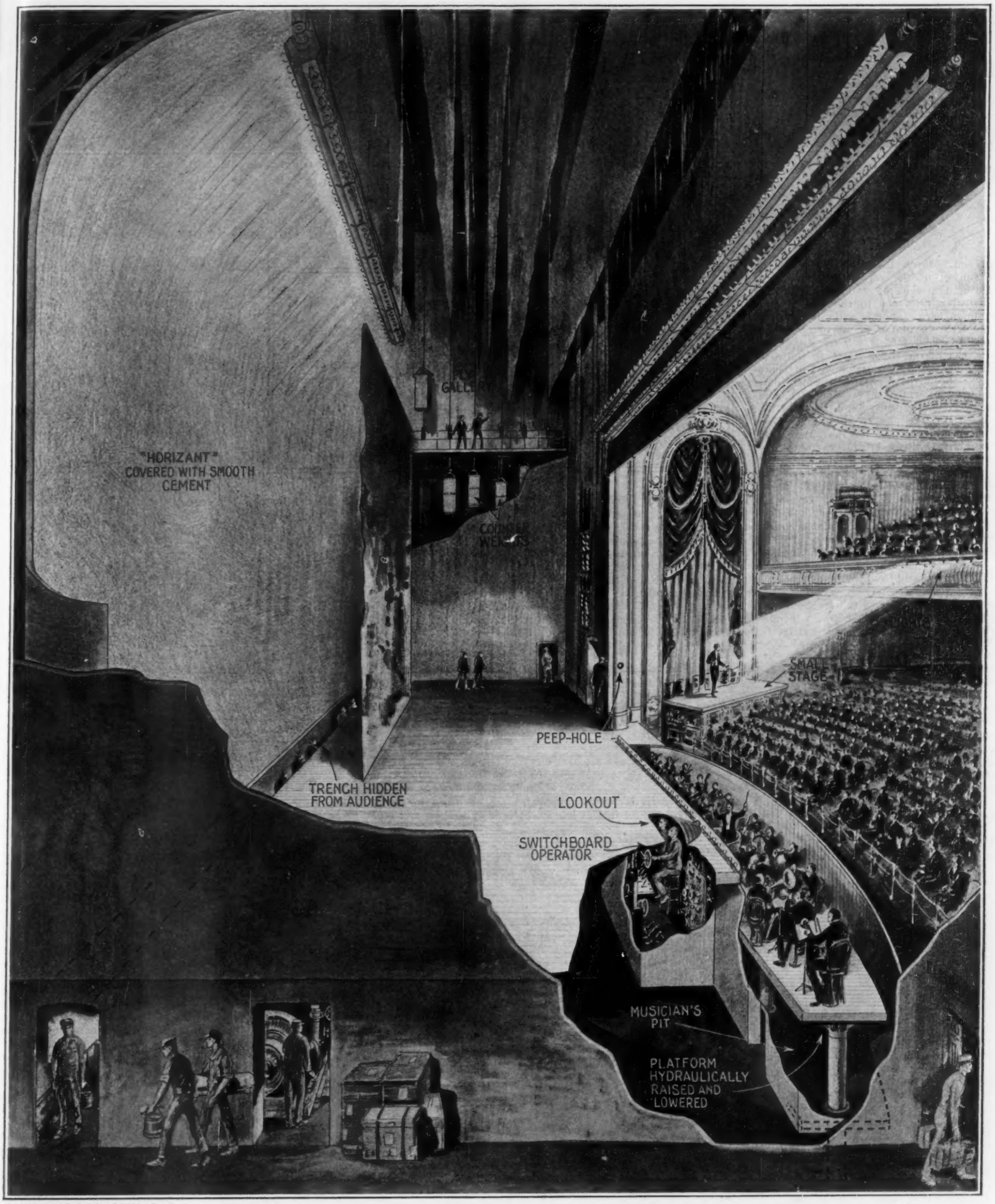
"We are not dragging art," declared Mr. Carroll, "into the mire of industrialism. I do not think you will find a better appreciation of art in any other theater in the world. What we have done is simply to recognize established facts about human beings, and in applying them to the theater we have had to invent some new devices and discard many old ones, and have made the best use possible of those already at our disposal."

The theater, from the standpoint of seating capacity, is not a large one, having 1026 seats. This makes it possible so to arrange them that every seat is in direct line with the stage and there is hardly any choice, except as to distance from the stage, of any two seats in the house. Here is applied democracy for the audience, too.

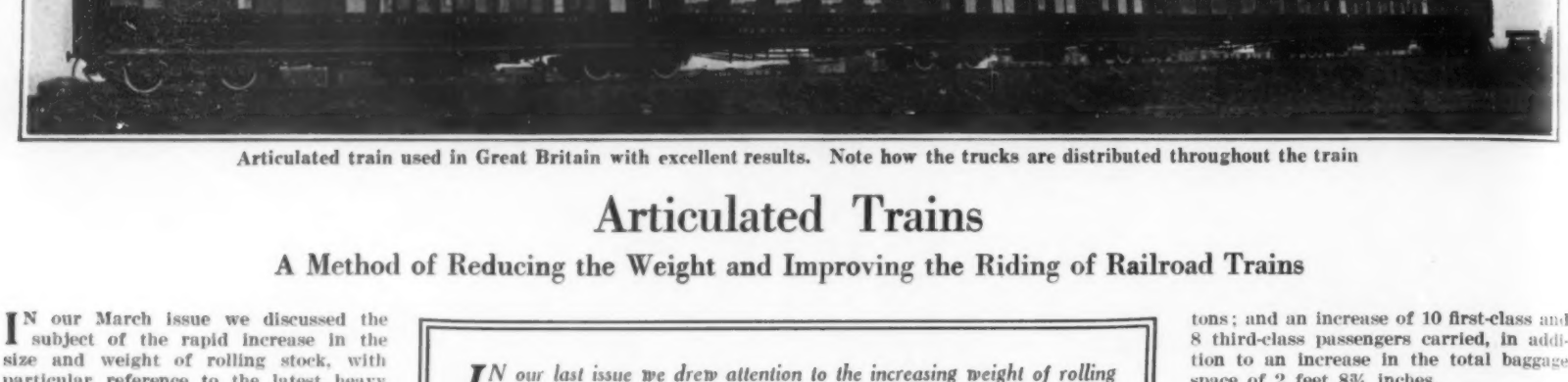
Indicator for Emergency Landing Grounds

THE British Air Ministry is conducting tests with a new type of indicator for emergency aircraft landing grounds. The indicator takes the form of a large T-shaped steel frame over which is stretched white canvas. The frame will also be fitted with a vertical fin. This device will be mounted on a prominence; for instance, the roof of a small building, and will operate in the same manner as an ordinary weather-vane. The white canvas will make the device visible to airmen and they will be able to descend, gliding down head to wind.

Acetylene will be housed in the building on which the device is mounted and will illuminate the T at night. The wind strength will be registered and will operate a series of colored lights, so that airmen, by noting the color of the light, can determine the wind force along the ground.



GENERAL SCHEME OF THE STAGE AND ITS ACCESSORIES AT THE NEW CARROLL THEATER IN NEW YORK, SHOWING THE MORE IMPORTANT OF THE POINTS IN WHICH IT DEPARTS FROM THEATRICAL TRADITION



Articulated train used in Great Britain with excellent results. Note how the trucks are distributed throughout the train

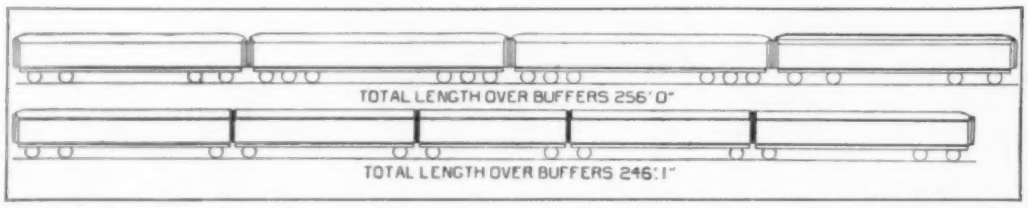
Articulated Trains

A Method of Reducing the Weight and Improving the Riding of Railroad Trains

IN our last issue we drew attention to the increasing weight of rolling stock, and to the fact that the railroads were hauling much unnecessary deadweight over their lines. It was suggested that the great length of the cars was in some measure responsible for this condition. The present article affords a most opportune study of the question; particularly as the economies set forth have been gained in trains that have been in service for many years. These English cars would be too short, of course, for American requirements; but the principles on which they are built are sound, and the results are well worth careful study by our master mechanics and car builders.—THE EDITOR.

IN our March issue we discussed the subject of the rapid increase in the size and weight of rolling stock, with particular reference to the latest heavy Pullman cars. Shortly after that article was written, and very opportunely, we received from Mr. H. N. Gresley, Chief Engineer of the Great Northern Railroad, England, the set of drawings and photographs herewith reproduced, which show the way in which that company has increased the capacity and reduced the weight of its passenger rolling stock. Mr. Gresley writes us that the Great Northern Railway has over 200 sets of articulated couches in use, some of which have been running for many years with such satisfactory results that the use of the system is being extended. Briefly stated, what the company has done is to carry the ends of adjoining cars upon a single truck, in such a way that the couplings rest upon a common bearing, and the coupling pin of the cars serves also as the king pin of the truck.

In the articulated principle, two or more carriages are permanently coupled together as shown in our illustrations. Each train, whether of two, or five, or ten cars, forms a unit, the trucks of which are so disposed that the distances between their centers throughout the train are all equal. In the train illustrated, trucks are placed under the outer ends of each train, the other trucks being placed under the adjacent ends of the car bodies forming the system. Sets of five bodies on six trucks have been running for many years on the Great Northern; and there is no constructional reason, or any other apparent reason, why trains consisting of 10 or 15 such cars should not be built, where the traffic calls for the use of larger units.



Although the articulated train carries 18 more passengers than the standard train (upper diagram) there is a saving of 10 feet of length, 21 tons of weight, and eight pairs of wheels

There are four principal advantages which have been proved in the experience of the company, with these trains.

1. *Reduced First Cost.*—Because the number of trucks is reduced there is a reduction in the total weight of the train; and because the trucks and wheels form the most costly parts of the train, both from a constructional and maintenance point of view, there is a considerable reduction in the total cost.

2. *Reduced Weight.*—The reduction in the weight of a train depends upon the number of cars forming the train unit, the longer the train the greater the ratio of weight saving. Thus, as shown in one of the diagrams, the reduction for cars with four-wheel trucks ranges from 10 per cent to 14 per cent. Where six-wheel trucks are used the reduction may run up to over 20 per cent.

3. *Reduced Running Cost.*—Reduced cost of operation is due to the reduced weight and decreased train resistance. This is, of course, most marked in the case of electric trains, since the consumption of current is practically proportionate to the dead weight of the train.

4. *Improved Riding of Cars.*—From the standpoint of the passenger, the most important quality is the improvement in the riding of the cars. This is due to the fact that there is no overhang of the bodies beyond the trucks, and that the adjacent ends of the bodies are carried on a common truck center. It is well known that the most comfortable part of a car is the center portion lying between the trucks, and this is due to the fact that there is here a minimum of lateral movement when entering curves. On the other hand, the most noticeable lateral movement is felt at the ends of the coaches, or where they overhang the trucks. Of course, in an articulated carriage there is no end overhang.

We are also informed that the tendency to rolling is damped out in the articulated train since, although the individual cars are free to adapt themselves to the curves, all relative movement laterally, or any tendency to roll between any two of the car bodies is prevented. It follows naturally that the articulated cars follow the true center lines of the track, and do not tend to nose from side to side, as sometimes happens with the trains mounted on the standard system.

Attention is directed to the two illustrations showing a four-car, main-line train of the standard type, and a five-car train of the articulated type. The five-car train is 246 feet 1 inch over all as against 256 feet for the four-car train, a saving in length of 10 feet. There is in the articulated train a decrease of eight pairs of wheels; a decrease in the total weight of nearly 21 tons; and an increase of 10 first-class and 8 third-class passengers carried, in addition to an increase in the total baggage space of 2 feet 8¾ inches.

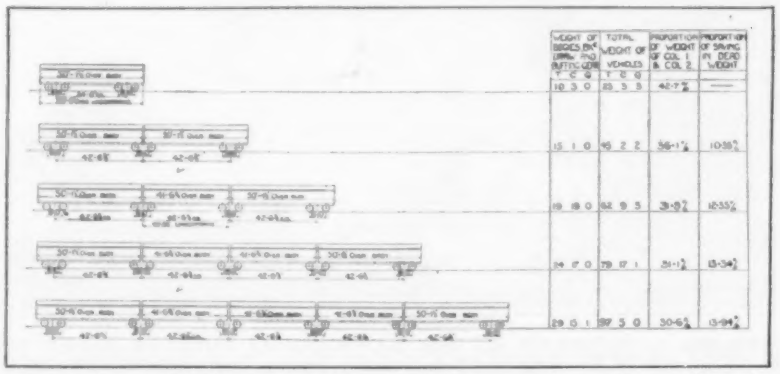
In a comparison of two other trains, in the articulated train there was a reduction in weight per linear foot of the train of 140 pounds, or 11.5 per cent, and there was a reduction in dead weight per passenger of 763 pounds per foot run, or 27 per cent. That these economies have not been obtained by any considerable reduction in the space per passenger, and certainly not with any noticeable reduction in his comfort, is shown by the accompanying view of the interior of one of the cars.

Dining Car with Electric Cooking.—Another feature of these trains which is entirely novel is that electricity, for the first time so far as we know, has been applied for cooking in the dining car trains. Current for the cooking apparatus is supplied by two generators supplemented by a battery. Each generator, which is belt-driven, is provided with self-contained automatic pole changers, and is rated at six kilowatts. As the length of the run between London and Leeds, where these cars are in service, is comparatively short, lunch has to be served soon after a start has been made. Hence, connections are provided by which current can be drawn from the terminal station supply, and the cooking be commenced before the start of the trains.

Across one end of the kitchen is the main cooking range and roasting oven, with a steaming oven above it; and above this are a grill and hot water tank. There are also a boiling range with four hot plates, two 10-gallon boiling pans for vegetables, a hot cupboard for heating the plates required, and an electric fish fryer. This installation has proved so satisfactory that other trains are to be suitably equipped.

In the article above referred to, as published in our last issue, it was pointed out that a considerable saving of weight could be effected by reducing the length of the cars, or to be more exact, reducing the distance between the bearing points of the car bodies upon the trucks. It may be contended that by the use of the articulated system the distance between supports is increased and the bending stresses, therefore, become greater, with a consequent demand for greater strength and weight in the structure of the car on this account. Undoubtedly this is true, but it should be understood that the articulated system presupposes the use of cars of comparatively short length. There is a length, beyond which the projection of the center of the car, beyond the inner rail on a curve, would become objectionable; although the cases in which this would happen would be rare, except on roads having unusually sharp curvature.

It will be noticed from the diagrammatic comparison at the bottom of this page that the articulated cars are only 47 feet in length. Evidently the fact that the points of support are outside the car bodies instead of eight feet in from the ends has not involved a heavy construction in the car body. This is doubtless due in some degree to the way in which the steel channels of the under-



Comparison and table showing the main differences between the weights of articulated coaches and standard coaches

frame have been brought in and concentrated near the end bearings.

Our railroad officials are straining every nerve to cut down operating costs. Here, in the elimination of dead weight, would seem to be a field of action upon which they might make a study of the problem to good advantage.

The Toronto Meeting

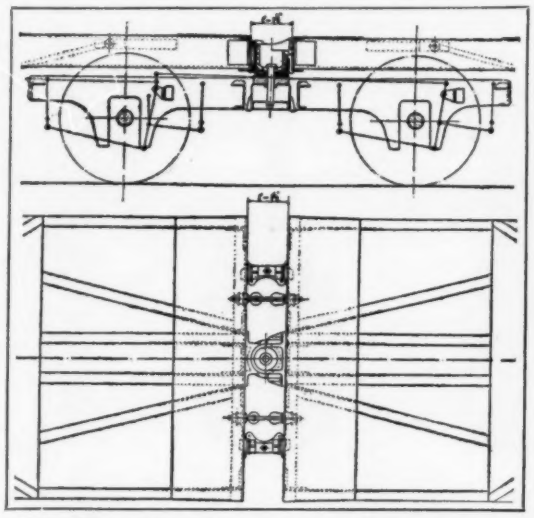
THE thirteenth annual meeting of the American Phytopathological Society was recently held at Toronto, Canada. Prof. J. H. Faull of the University of Toronto had charge of the phytopathological exhibits. Section G of the A. A. A. S. and the Mycological Section of the Botanical Society of America assisted as usual with the program where the subjects and discussions were of mutual interest. Of the 2000 present at the general meeting, about 200 were botanists. The next president of the Botanical Society of America is H. C. Cowles. The new officers of the Phytopathological Society are: E. C. Stakman, president; N. J. Giddings, vice-president; Perley Spaulding, editor-in-chief, with L. L. Harter and G. M. Reed, assistants. The meeting next year will be held in Boston.

The most popular address was probably that by Prof. Bateson on "Evolutionary Faith and Modern Doubt." The symposium on the "Utility of the Species Concept" was important and well-timed. Mosaic diseases occupied a prominent place at the meeting, about 20 papers being presented dealing with this subject. Dr. Duggar experimented with the mosaic disease of tobacco and found that the "virus" filters through porous cups as a liquid and therefore cannot be a germ or similar organism. He termed it a "living fluid contagion." Experiments by Johnson, who has long worked on tobacco mosaic, led him to make the following statement: "It seems, therefore, that these results furnish evidence against the enzymatic theory of mosaic while at the same time they favor a parasitic hypothesis, since the temperature curve for the development of mosaic corresponds closely with that of the development of many of the plant pathogens."

Freda Detmers discussed the parasitic effect of polypore, *Poronidulus conchifer*, on elm branches, claiming that it seems to be more injurious at times than suspected. L. M. Massey discussed "Fusarium-rot" of the Gladiolus. The corms become infected in the field and the rot advances in storage. The fungus seems to be *Fusarium oxysporum* Schecht. A poplar canker, caused by *Hypoxylon pruinatum*, was described by Povah. This disease is a trunk canker, which blackens the sapwood. It is very serious in certain sections. W. H. Snell spoke of the effect of heat upon the mycelium of certain structural timber-destroying fungi within wood, concluding that heating structures affected with decay to 47-48 degrees Centigrade by means of the heating systems, as has been suggested, would not kill the fungi even in moist cotton weave sheds, although the drying effect would be beneficial in certain types of structures. The application of these results to the effect of kiln drying upon structural timber decay was pointed out. R. J. Blair spoke of experiments with storing wood pulp in water to protect it from fungi. An experiment was carried out using several kinds of commercial pulps in order to test the preservative value of water upon sheets of pulp immersed in it. After an interval of 17 months the pulp was examined and tested for freeness. It was then made into small sheets of paper, which were tested for bursting strength and for tensile tear. The pulp stored in water came through the test in much better condition than that which was piled on a shed where it was given an opportunity to dry out.

Air for the Miners

WARNING that in every abandoned shaft or pit or, in fact, any old working where the air has been stagnant for a considerable time, there is always danger of oxygen deficiency, with consequent peril to the life of anyone exploring such workings, is given by the United States Bureau of Mines. Frequently lives are lost through the cleaning out of old wells, which accidents, as a general rule, are also caused by impure



This shows ends of two cars carried upon a common truck. Note the combined coupler and kingpin

atmosphere. Instances of loss of life through a lack of proper precautions in entering abandoned exploratory shafts and pits are frequently reported to the Bureau of Mines. Recently a geologist was killed through entering an abandoned exploratory shaft in California without making a preliminary test of the shaft atmosphere. In Minnesota a mining engineer lost his life from being overcome by poisonous gases while sampling a shallow pit in iron-ore formations.

All the gases found in pure air are without color, smell or taste, but no reliance can be placed on these senses for detecting impure air, declares the Bureau of Mines. Air so impure that it will not support life may not have any disagreeable odor or choking effect that would warn the breather to escape. Oxygen deficiency in the air of old shafts and pits or other workings may be caused through replacement by carbon dioxide or methane and absorption of oxygen by the rock and timber.

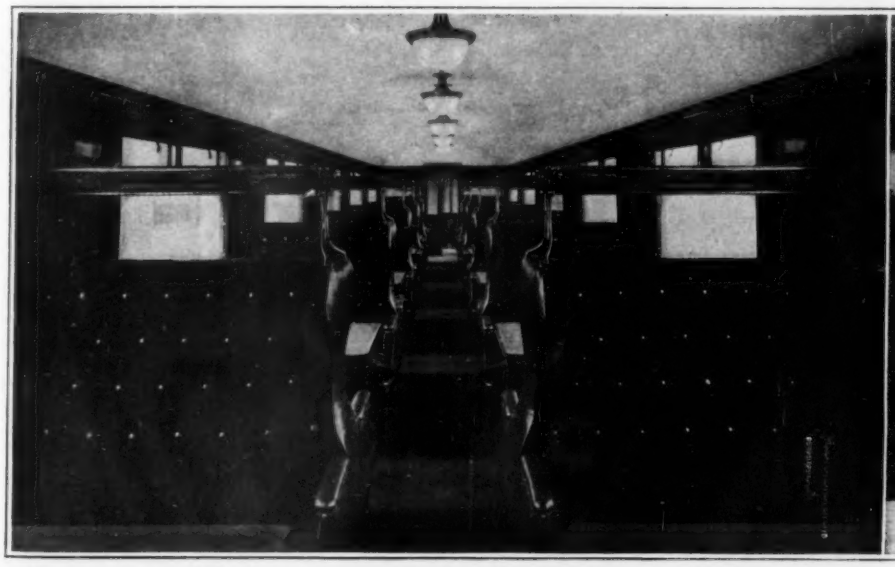
In old metal exploratory shafts carbon dioxide is more commonly present than methane. Carbon dioxide gas is generated by decaying timbers, is given off by certain rocks, and may be carried into the shaft by circulating waters. This gas, being heavier than air, tends to settle in the still atmosphere of the shaft rather than mixing with the air. Thus at one point in the shaft the air may support life, but a very short distance below consist of irrespirable "black damp." In openings in coal measures some oxygen is absorbed and some carbon dioxide is given off by the coal. Old abandoned workings often contain large quantities of black damp, because the atmosphere is motionless and the oxygen has been removed by long contact with the coal. In addition to carbon dioxide, methane (fire damp) is also given off by the formations.

When the oxygen of the air in a mine opening is so low that a miner's oil lamp, candle, burning paper, or torch is extinguished, a man should not go or stay in such an atmosphere. A candle or an ordinary miner's safety lamp will be extinguished in an atmosphere containing less than 17 per cent oxygen, and an acetylene or carbide lamp in air containing 12 or 13 per cent oxygen.

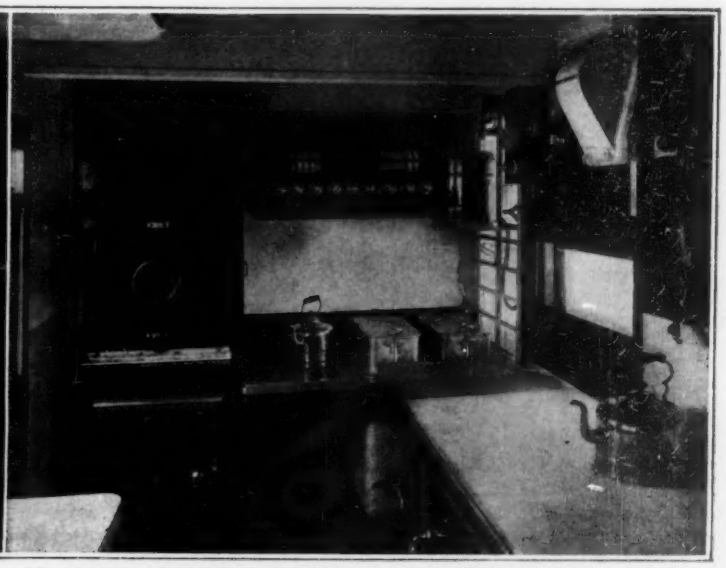
While a man might live or even work in air containing 17 per cent oxygen, it would be a most hazardous undertaking to enter or remain in mine air that extinguishes a flame, since this shows only that there is less than 17 per cent but not how much less. Before any abandoned shaft or pit is entered one should lower either a lighted candle or lantern or safety lamp to ascertain the condition of the air. If the flame is extinguished, and there is not sufficient oxygen in the shaft air to support life, one should not attempt to enter the shaft until the air is stirred up by some common means.

Raising and lowering a bucket several times, to bring in fresh air from the surface, is common practice. After working it up and down vigorously for a few moments the air at the bottom of the shaft should again be tested with a flame. If there is no bucket available, the air should be churned by means of a blanket, tent fly, inverted umbrella, or other large, light object, attached to a rope. Methane may be expected in abandoned shafts or pits driven in coal measures or carbonaceous slates, or where a heavily timbered shaft is partly filled with water. If methane is suspected it is best to lower nothing but a miner's safety lamp. If the light is not extinguished the descent can be considered reasonably safe. When no safety lamp is available, and it is necessary to test with an open light, care should be taken to withdraw immediately all persons in close proximity to the shaft or pit as there may be an explosion. It would be safer to clear the shaft before making any test with an open flame. It is common practice among metal-mine prospectors to throw burning grass or lighted paper into an abandoned pit or shaft, but there is a possibility of fire starting if there is combustible material in the shaft bottom.

Generally there is no physiological warning of oxygen deficiency in the air. The first decided feeling is one of extreme weakness accompanied by dizziness, better described as partial paralysis, and the victim collapses practically without warning. To guard against this danger a man should not enter old workings without having a rope tied around his body and at least two men on the top. The rope should be kept taut. Then if a distress signal is given the explorer will not only be prevented from falling, but can be quickly pulled to fresh air and his life saved.



Interior of one of the first-class cars, showing the upholstering, also hatracks carried above the backs of seats



The kitchen, in which the cooking is done by electric current furnished by generators, belt-driven from the axle

At the Sending End of Radio

Spanning the Atlantic with Fifty Watts of Electrical Energy, and a Few Facts Regarding CW Transmitters

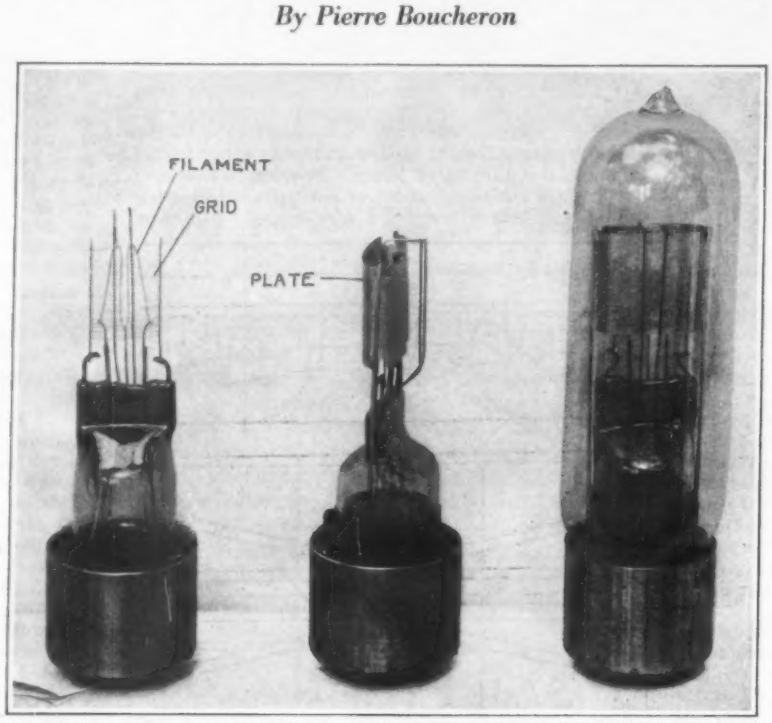
By Pierre Boucheron

FIFTY watts of electrical energy was recently used in the successful spanning of the Atlantic, without cables or wires or other physical connection. Fifty watts—a mere trifle as electrical consumption goes! The average electric light draws 50 watts, yet the light which it gives forth could hardly be detected at a distance of two or three miles. Yet when this same amount of electricity was applied to a highly efficient continuous-wave radio transmitter it spanned the 3600 miles of land and sea separating the amateur radio operator in this country, wondering if he was "getting across," and the representative of a leading American radio organization, temporarily located in Scotland with a collection of receiving apparatus for the purpose of picking up the attenuated waves from fellow workers back home, thus proving that low-power transmitters, in the hands of capable operators, could connect the Old and the New Worlds.

That marvelous feat of signaling, which has given rise to considerable comment on the part of scientists and engineers throughout the country, took place during the latter part of December, when the so-called amateur radio operators of the United States, through their official association, the American Radio Relay League, conducted a series of tests to determine the possibilities of international amateur radio communication. To this end they sent an expert from their ranks, Mr. Paul F. Godley, to England with detailed instructions to "listen in" between 7 P. M. and 1 A. M. each night from December 7 to December 16, inclusive. Definite operating periods were arranged for amateur stations which in preliminary tests had qualified for transmissions of 1000 miles or more; also, other time intervals were allotted as a free-for-all transmission period.

There were many doubting Thomases in and out of amateur radio circles, who insisted that transmission on low wave lengths—200 meters or less, and at small power outputs—not to exceed 1 kw.—was a ridiculous impossibility, and that sending a man over to Europe to prove it was even more so.

Nevertheless, the amateurs of America were in a fever heat of excitement when the first test night came. Needless to say, practically every amateur station in the country, even those equipped with comparatively small transmitting sets, began calling their colleague stationed at Ardrossan, Scotland, where he had erected his own personal receiving set, utilizing such supersensitive devices as the famous Armstrong regenerative circuit in connection with vacuum tube amplification.



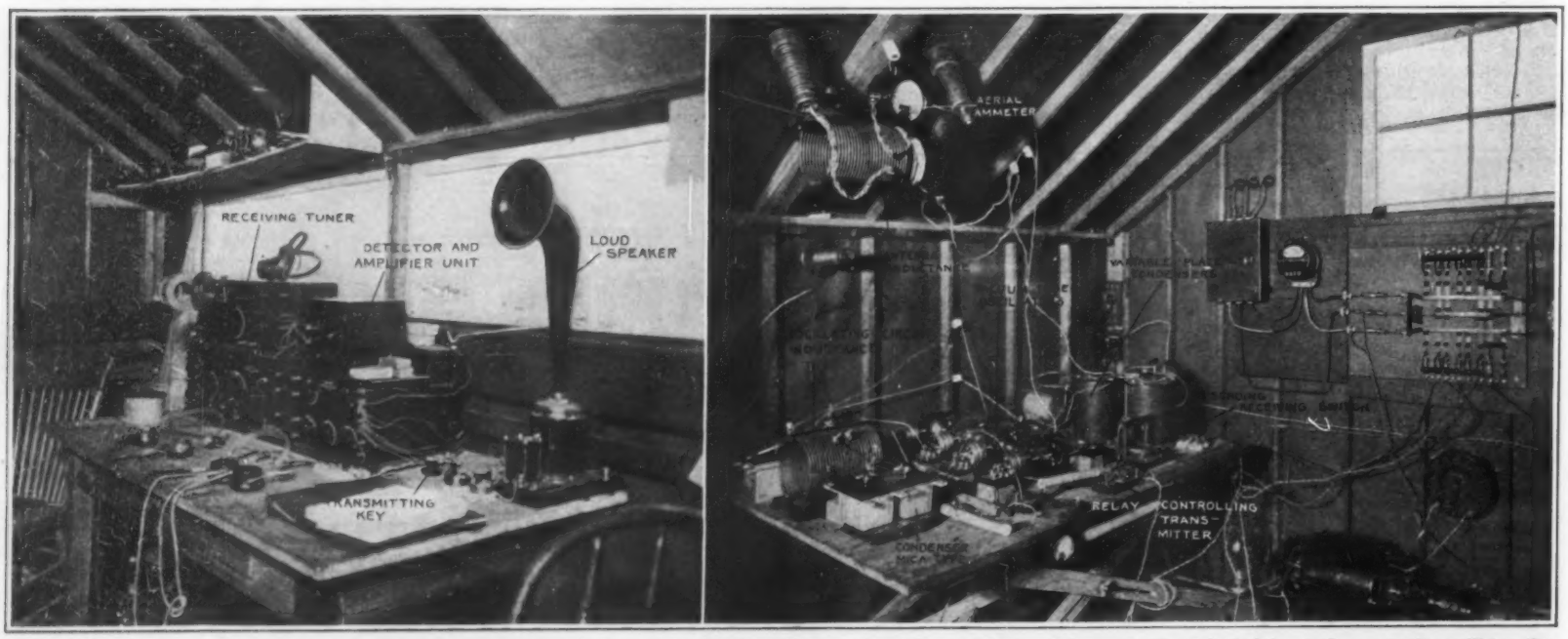
Oscillating vacuum tube of 50-watt rating, such as used by 1RU of Hartford, Conn., in transmitting across Atlantic with 50 watts of energy

On the first night of the tests Mr. Godley reported having heard an American amateur signing the call letters 1AAW. This, however, could not be verified, as the official owner of this call was not operating at the time specified. On the second night the observer reported no signals heard on account of a severe storm prevailing at the time in Scotland. The storm caused, among other physical disturbances, excessive static discharges through the air; and static, it will be recalled, is the *bête noir* of all radio activities.

On the night of the 9th, however, conditions were ideal, and for the first time in the annals of amateur radio, short-wave, low-power, transatlantic communication became an accomplished fact. It was at this time that Mr. Godley reported in his daily return radiogram sent via the high-power commercial route, that he had picked up the signals of the American amateur station 1BCG, and that these signals were strong and reliable. After this, and until the closing day of the tests, December 16, 1BCG and other stations continued to "carry across the pond." In all, these stations numbered 27. Not only were some of these stations heard clearly in England and in Scotland, but in one case an entire message was copied in Amsterdam, Hamburg, and in the Catalina Islands, proving that the signals were radiating equally well in other directions.

So we behold the amateur radio art spreading out to international proportions. In the future it may well be that Smith of Chicago will spend an evening playing chess with his friend Watkins in London, whom he has never seen; the next evening Smith may hold a good-natured discussion on international politics with MacPherson of Glasgow; the third evening Smith may practice the French language with Cartier of Paris. Why not? It can be done; and surely a radio get-together party of this sort must help to foster amicable relations with other nations as no other agency can do.

Perhaps the most powerful of the stations competing in the recent epoch-making tests is 1BCG, the first to be heard. This plant, which employed a power input of about 900 watts for the transatlantic tests, is located near a lonely back road on the outskirts of Greenwich, Conn. It was somewhat hurriedly erected in order to compete in the transatlantic tests. Another touch of romance is that 1BCG is not a one-man station: it is owned and operated jointly by some of the country's most representative radio experimenters, who have worked, played, eaten and talked radio for the past 15 years—men, not so long ago boys, who have seen the art graduate from Marconi's crude 10-inch spark coil and the unreliable coherer, to the present-day highly effective vacuum tube transmitter and receiver. These men are Major Edwin H. Armstrong, who devised the now far-famed regenerative circuit; E. V. Amy, a short-wave antenna expert; J. F. Grinan, who, strangely enough, was not only the



Right: Transmitting corner. The four transmitting vacuum tubes can be seen on the bench; in this case four 250-watt tubes are being used. One tube is being used as a master oscillator, the other three as amplifiers of the energy produced by the initial source. The total input to the plates of these four tubes was 989 watts. The radiation was 6 amperes, with a total operating efficiency of 52 per cent, or approximately 558 watts of antenna energy. The transmitter operated on a wavelength of 230 meters. *Left:* Receiving desk of the same station, with the actual transmitting key which controls the relay key on the transmitter table. Modern vacuum tube receiving units are used here

Two views inside the 1BCG amateur station which transmitted across the Atlantic during the recent tests

first man to send an amateur radiogram across the American continent, but who also was the first to send an amateur transatlantic message of congratulation, which was received in Scotland by Mr. Godley even to the last dot; while George E. Burghard, Minton Cronkhite and Walker Inman complete the personnel of 1BCG.

This station is housed in a small portable building, and the long winter nights were cold, but not too cold to dampen the zeal of these dyed-in-the-wool radio men. Our cover illustration depicts a thrilling moment in the little shack during the transatlantic tests, as the writer, who attended these tests, recalls it.

An analysis of the report on the technical facts connected with these tests indicates that of the 27 stations heard across the Atlantic, 24 employed the new form of radio transmission known as the continuous-wave or "C.W." method, with power inputs ranging in most cases from 50 to 100 watts. This new system has made great strides within the past year, owing to its remarkable carrying powers, selectivity, simplicity and low cost, as compared with the older spark type transmitter.

Briefly, the difference between the continuous-wave and the discontinuous or damped-wave method is this: In C. W. we have a system of transmission which generates and propagates a perfectly uniform wave of *constant* amplitude. Such a wave, after leaving the antenna, travels through space without losing its form. The distance this kind of wave will travel is, of course, entirely dependent upon the amount of power at the initial source. Modern C. W. may be obtained by several distinctly different methods. The most popular method, at least among amateurs, is realized through the use of the oscillating vacuum tube. Here we have the somewhat magical performance of a glowing incandescent lamp generating a constant supply of high-frequency oscillations, which is ideally suited to radiation purposes through the simple expedient of controlling the electronic flow occurring between the lighted filament and a surrounding plate charged with positive electricity.

In the discontinuous or damped method the emitted wave is not continuous in its passage through the ether. Furthermore, the amplitude of its oscillations is not constant. Instead, after such waves have been given their first send-off by the initial power stroke of the transmitter, they rise to sudden great height and gradually fall lower and lower in amplitude until *damped* out completely. The next stroke of transmitter energy causes them to rise again, and the rising and falling process keeps on indefinitely, depending on the amount of energy back of it. Thus this sort of discontinuous or damped wave, as it is technically called, travels through space until exhausted; likewise, its "carrying" powers are entirely proportional to its initial amount of energy. It is produced by the spark type of transmitter and has been in use ever since the inception of wireless communication.

C. W., being constant in amplitude, does not dampen out and is, therefore, known as an *undamped* wave. The discontinuous wave, on the other hand, not being constant in amplitude, dampens out quickly and is, therefore, known as the *damped* wave. The first is a much better medium for bridging great distance at small cost, and, therefore, is slowly supplanting the older method. Then, too, it has decidedly selective qualities not readily attributed to the spark system. In other words, a radiated C. W., when intercepted by the receiving station, is so sharp and constant in character that the receiver must be tuned exactly to its wave length, otherwise it will not affect the instrument. When we consider that there are to date 13,835 amateur transmitting stations in the United States, and nearly 300,000 receiving units, this sharpness of tuning is a most important factor in eliminating interference between stations; indeed, in time to come it must supersede entirely other less selective methods of transmission.

Possibly the second most attractive feature of C. W. is its great economy in power consumption. For instance, power for power, C. W. will carry five times the distance spanned with the older spark method. Indeed, it is not uncommon for a 1-kw. vacuum tube transmitter to outdo a 5-kw. spark type set. By the same token, the over-all efficiency of a vacuum tube transmitter is quite high as compared with the spark, the first being close to 70 per cent, while the latter is seldom over 35 per cent. This greater efficiency, please note, means considerable economy in power consumption, and quite naturally finds ready approval among communication engineers. Still another decided advantage of the C. W. method is its comparative simplicity of apparatus, eliminating, as it does, cumbersome transformers, huge condenser jars and ponderous spark dischargers of the stationary or rotary types. C. W. being practically noiseless, operating conditions are greatly improved. Moreover, the operator is enabled to send and receive almost simultaneously, without having to manipulate large change-over switches.

The use of vacuum tubes in transmission makes possible not only C. W., but also I. C. W., or interrupted continuous wave operation, as well as radio telephony. These three functions of the vacuum tube have played a most important rôle in the present-day usefulness of radio in general. C. W. has already been described. I. C. W. is practically the same form of transmission with the exception that a mechanical interrupter is inserted in the radiating circuit of the transmitter in order to "break up" the emitted waves so that they will be heard at universal audible tones at the receiving end; otherwise, a special receiving circuit must be employed to render the waves audible, as is done in C. W. work.

Radio telephony is, so to speak, a combination of both C. W. and I. C. W. That is, a radio telephone transmitter is normally emitting continuous wave oscillations at radio frequencies—frequencies above 10,000 cycles per second. When speech takes place the oscillations are modulated by the characteristics of the voice, and these changes cause a superimposed rising and falling amplitude of the wave.

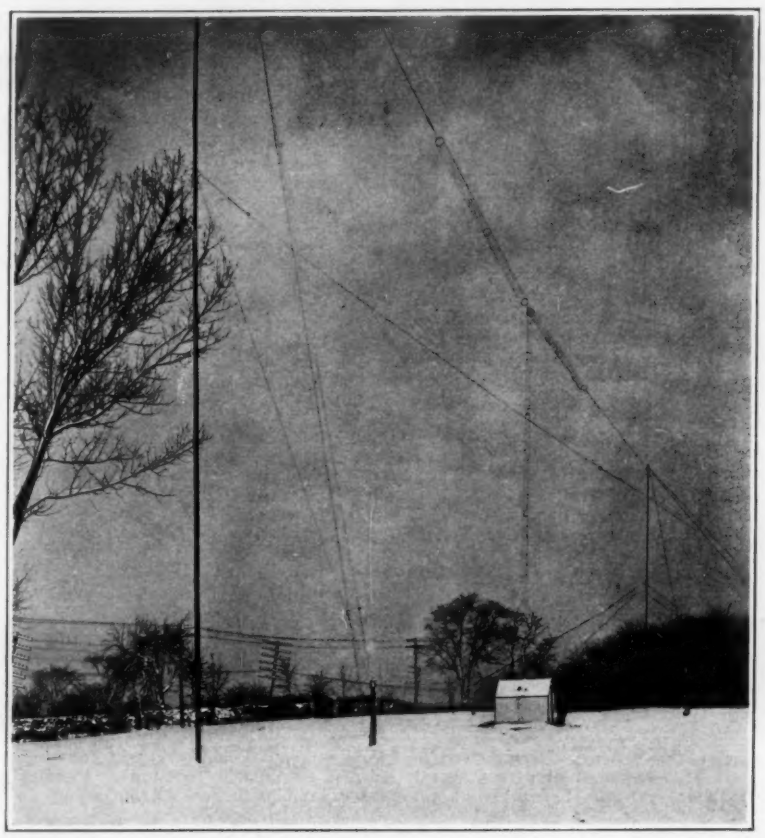
It is obvious that the continuous wave at once lends itself admirably to any requirement of the present-day radio art. First, it may be used in its natural wave form (C. W.) for long-distance radio telegraphy, whether for amateur or commercial purposes; secondly, it may be modified as in I. C. W. (interrupted continuous wave) to meet the receiving requirements of the older spark type installations still in use on thousands of vessels and land stations; and thirdly, it may be modulated by the human voice, thereby permitting radio telephony, now so popular owing to the great success of the radio telephone broadcasting station.

The rôles which C. W. is capable of playing, combined with its inexpensiveness, simplicity, selectivity and carrying powers as recently and conclusively proved, make this the ultimate transmission system—the one which will supplant all other present-day systems for amateur short-wave, long-distance communication. In commercial work it also finds ready application, especially where dependable medium-power communication over medium distances is required. To this end, commercial transmitting units of the vacuum tube type are today fitted for C. W., I. C. W., and radio telephone operation, any one of which is instantly available simply by the turning of a master control switch.

The success of the recent amateur transatlantic tests had no sooner been reported than persons, not familiar with operating conditions, began to ask why it was possible for amateurs to operate overseas on such low-power outputs as 50, 100, 250 and 900 watts of electrical energy, when it took as much as 200,000 watts (200 kw.) for commercial stations to bridge similar distances; a quite natural question, and one that is easily answered. To begin with, for the amateur operator to span the Atlantic during a special prearranged period, at the most favorable season of the year, under particularly advantageous operating conditions, was one thing, and to furnish the public with reliable commercial service over the same distance during 24 hours of each day of the year, winter and summer, through heavy atmospheric disturbances and under the worst as well as the best operating conditions, is quite another thing. They compare as day with night: one means transatlantic communication at times; the other means transatlantic communication *all the time*.

In extolling the advantages of C. W. and its various applications, one fact stands out in bold relief, and that is the predominating part played by the vacuum tube. Without this wonderful device, so young in years yet so old in its training and broad usefulness, many of our present radio achievements would not exist. Today the vacuum tube—call it the electrical acrobat or the modern Aladdin's lamp, if you will—finds many applications in the electrical industry, but certainly none so useful as in radio work, where it plays stellar rôles in both transmission and reception of radio telegraphy and telephony.

In a few brief years we shall see the vacuum tube responsible for feats of long-distance communication undreamed of today. But who is responsible for this wonderful achievement? The answer is to be found in the research laboratory, where year in and year out, unsung and seldom mentioned investigators toil quietly and indefatigably that mankind may be benefited.



The mast to the right is 100 feet high, the one at the left is 80 feet. The antenna is of the so-called cage type, T-shape, a new form of aerial construction especially effective in continuous-wave transmission on account of its uniformity. The flat-top section of this antenna is 100 feet long and its down-lead is placed in the exact center, and measures about 80 feet long. Instead of a ground connection, a counterpoise forms the other part of the radiating system. The counterpoise is simply a secondary antenna system, located a certain distance below the actual antenna and a certain distance above the ground

General view of 1BCG, showing the station building, the masts and the antenna system

The Last Glacial Epoch

MR. C. E. P. BROOKS (*Quarterly Journal R. Met. Soc.*, July, 1921) assigns the date 30,000 to 18,000 B. C., for the last great glaciation in northwest Europe (Ireland, Scotland, Scandinavia, and the Baltic). Some remains of glaciation continued until 6000 B. C.; after some intermediate phases the date 1800 B. C. to A. D. 300 is assigned to the Peat-bog Phase, when the climate was cooler and more moist than at present. These changes are attributed chiefly to alterations of elevation; increased elevation has the double effect of producing glaciation on land and of closing the Straits of Dover and other channels for the warm currents from the Atlantic. Mr. Brooks also assigns considerable weight to the 1800-year cycle in tide-generating force announced by Mr. O. Pettersson. But it is very doubtful whether this cycle will explain any appreciable climatic changes. It does not mean that all the tides are higher at one of these 1800-year maxima, but merely implies that there are a few tides in the year very slightly in excess of those at other epochs, just as there are total solar eclipses of maximum duration at something like the same interval. Evidence of an approach to simultaneity in climatic changes in Europe and America indicate some cosmical cause; but the suggestion of a long-period variation in solar output (analogous to the short-period variations announced by Mr. Abbot) seems, to a commentator in *Nature*, more hopeful than the tidal cycle theory so long in vogue.

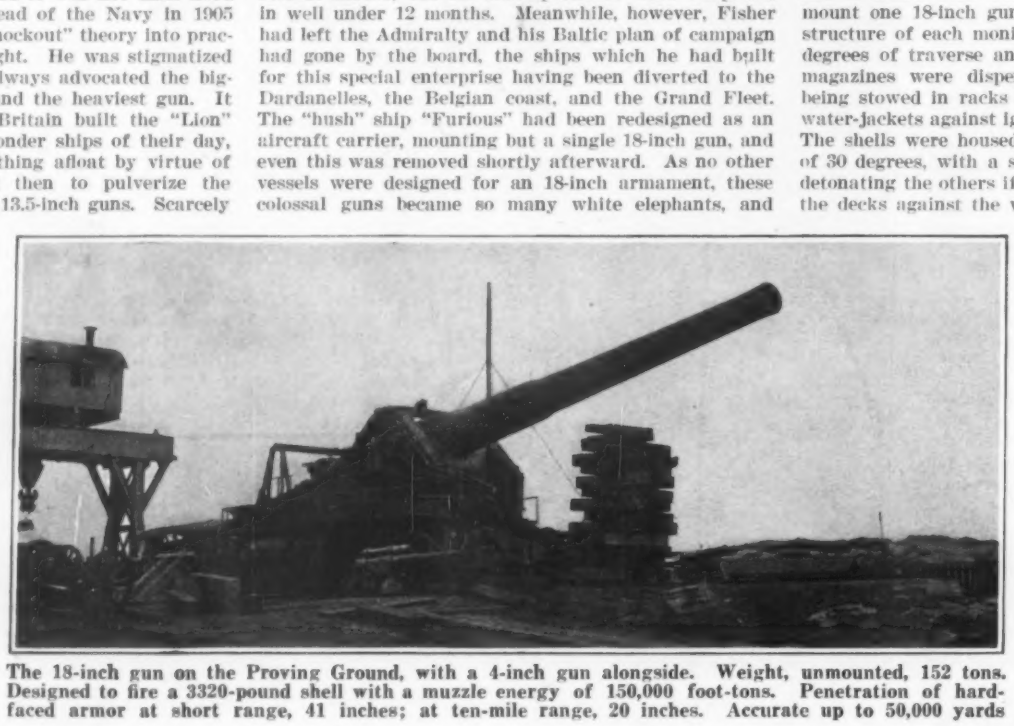
The First, and Last, 18-Inch Naval Gun

The Leading Naval Powers Have Agreed to Build No Guns Greater Than 16-Inch

By Hector C. Bywater

THROUGHOUT his long career in the British Navy the late Lord Fisher preached a doctrine of tactics which could be compressed into a single sentence: "Locate your enemy and knock him out with a succession of tremendous blows." As far back as the early eighties of last century he worked out, in collaboration with Sir Philip Watts, the naval constructor, the design of a "super-Inflexible," to be armed with eight 16-inch 80-ton muzzle-loading guns. This was rejected by the Admiralty of the day as being too costly a proposal, and it was not until Lord Fisher became professional head of the Navy in 1905 that he was able to put his "knockout" theory into practice by building the dreadnought. He was stigmatized as a materialist because he always advocated the biggest ship, the highest speed, and the heaviest gun. It was under his impulse that Britain built the "Lion" class of battle cruisers, the wonder ships of their day, and intended to overhaul anything afloat by virtue of their tremendous speed, and then to pulverize the quarry with salvos from their 13.5-inch guns. Scarcely had these ships been built than Fisher was aiming at something better, particularly in the way of artillery, and his next step was to introduce the 15-inch gun, firing a projectile of 1920 pounds, as against the 1400-pounder of the 13.5-inch and the 850-pound shell of the 12-inch gun. On being recalled to the Admiralty in October, 1914, he arrived with his pockets stuffed with plans for novel types of ships wherewith to smash the German fleet. He was the father of the famous "hush" cruisers—the "Glorious," "Courageous," "Furious," "Renown" and "Repulse," in all of which very high speed was combined with a battery of the heaviest guns then available. The first three were officially designated "light cruisers," although they displaced 18,600 tons. This was a specimen of Fisher's grim humor. The British Cabinet refused to sanction new capital ships, holding that the exigencies of the war demanded priority for destroyers and patrol craft; but they were willing to let Fisher build light cruisers. He promptly decided to go the limit by constructing three "whoppers"—to use his own expression; two of which were to be armed with four 15-inch guns apiece, and the third, the "Furious," with two 18-inch guns. All these ships were intended for work in the Baltic, where Fisher intended to dispatch a strong British squadron to cover a Russian landing on the German coast. His purpose was to outrange any artillery the Germans could bring up, and he therefore instructed Armstrong, Whitworth & Co. to design a gun that would shoot up to 25 miles. This was the origin of the 18-inch gun, the heaviest and longest-ranging piece of naval ordnance which has been built up to the present time. The new guns were put in hand early in 1915. As their dimensions were much larger than those of any gun built previously, the work involved technical difficulties of a serious nature, but the first specimens were completed in well under 12 months. Meanwhile, however, Fisher had left the Admiralty and his Baltic plan of campaign had gone by the board, the ships which he had built for this special enterprise having been diverted to the Dardanelles, the Belgian coast, and the Grand Fleet. The "hush" ship "Furious" had been redesigned as an aircraft carrier, mounting but a single 18-inch gun, and even this was removed shortly afterward. As no other vessels were designed for an 18-inch armament, these colossal guns became so many white elephants, and were finally offered by the Admiralty to Admiral Sir Reginald Bacon, commanding the Dover Patrol. Admiral Bacon was at this time working on a plan for the long-range bombardment of Bruges, the headquarters of the German U-boat flotilla in Flanders, and he therefore accepted the offer with alacrity. His first idea was to mount one or more of the guns ashore at Westende, whence they could pitch their shells into Bruges without difficulty; but the execution of this scheme was conditional on the Allied armies advancing sufficiently far along the Flanders seaboard to turn the Germans out of their positions on the coast. This, however, could not be done at the time, and Admiral Bacon was therefore compelled to devise floating platforms for his monster cannon. Three monitors were chosen for the purpose—the "Lord Clive," the "Prince Eugene," and the "General Wolfe." They had been hurriedly built in 1914-15, and each was armed with a couple of old 12-inch, 35-caliber guns taken from the "Majestic" class of battleships. As time was of vital importance, it was decided not to remove the original armament, but simply to mount one 18-inch gun on the after-end of the superstructure of each monitor, on a carriage capable of 15 degrees of traverse and 45 degrees elevation. Special magazines were dispensed with, the cordite charges being stowed in racks on the upper deck, protected by water-jackets against ignition by enemy shells or bombs. The shells were housed on the upper deck at an angle of 30 degrees, with a space between each to avoid one detonating the others if hit by enemy fire. To reinforce the decks against the weight of the gun and the force of the recoil a good deal of extra scantling was worked in. The gun itself was mounted behind a shield of thin plating as camouflage to represent armor. Unfortunately the work was not completed in time for the three monitors to carry out their bombardment of Bruges, and only the "Lord Clive" was able to discharge a few rounds at the enemy before the Armistice intervened. Admiral Bacon's program for the Bruges bombardment was to moor the three vessels behind a smoke-screen in a position at sea 24,000 yards from the Zeebrugge lock-gates and exactly in line with the Zeebrugge-Bruges canal. A few ranging rounds were to be fired at the lock-gates, after which the elevation was to be increased and 18-inch shells to be dropped right into the submarine shelters at Bruges. Spotting would have been done by aircraft. From the technical point of view it is a pity that the shooting did not come off, for it would have constituted a record in long-range naval gunnery.

Monitor "Lord Clive," with 18-inch gun on improvised mounting astern. Designed to shell submarine shelters at Bruges from a position 24,000 yards at sea from Zeebrugge



The 18-inch gun on the Proving Ground, with a 4-inch gun alongside. Weight, unmounted, 152 tons. Designed to fire a 3320-pound shell with a muzzle energy of 150,000 foot-tons. Penetration of hard-faced armor at short range, 41 inches; at ten-mile range, 20 inches. Accurate up to 50,000 yards

Except for its size, there is nothing particularly remarkable about the 18-inch gun. It is constructed on the wire-wound principle which has been in vogue in Great Britain for so many years, but which, in the opinion of many ordnance experts, has outlived its utility. Wire guns, it is true, have a generous factor of safety, and this was a powerful recommendation some 25 years ago, when powder was inclined to be erratic in its action, and gun-bursts were not infrequent. Nowadays, however, when the propellant is so much safer and the stresses to which the gun is exposed can be gaged to a nicety, the safety factor is of less importance. The wire gun is much heavier than the built-up type, and being also deficient in girder or longitudinal strength, it is liable to lose its accuracy. It is understood that British gun factors are reverting to the

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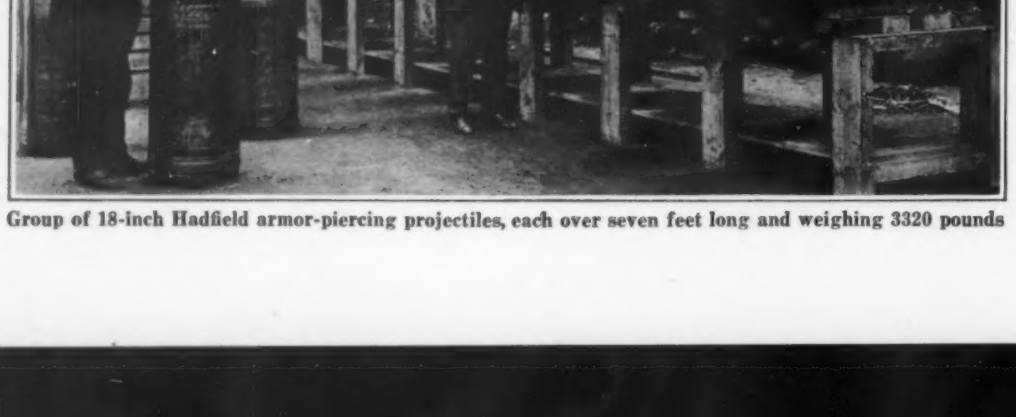


Group of 18-inch Hadfield armor-piercing projectiles, each over seven feet long and weighing 3320 pounds

Soaring Birdmen

A Study of Soaring Birds and a Review of Recent Glider Experiments in Germany

By Ladislas d'Orcy, M. S. A. E.

FOR the past two years an important movement has been under way in Germany with a view to solving the long-sought problem of artificial soaring flight, or motionless flight, without loss of height. This movement has gained a large impulse from the fact that it is directed by a central organization, the Association of German Model Airplane and Soaring Clubs, and also because it has the active support of some of the most influential German airplane constructors and aerodynamical investigators. Among these may be mentioned Prof. Prandtl, director of the aerodynamical laboratory at Göttingen; Prof. von Kàrmàn, well known for his theoretical work on the resistance of the air; Prof. Hugo Junkers, inventor of the all-metal monoplane bearing his name, and E. Rumpler and A. Fokker, the airplane constructors.

In addition, the German soaring movement derives a certain amount of patriotic inspiration from the fact that this branch of aviation was initiated some thirty years ago by Otto Lilienthal, the great pioneer of flying. Although Lilienthal's gliding flights from the top of an artificial hill 50 feet high afforded the starting point for the invention of the airplane by the Wright brothers, it is a matter of historical record that Lilienthal himself was much less concerned with the achievement of power flight—as were his contemporaries Ader, Langley and Maxim—than with the solution of soaring flight. Even when he was led to admit the desirability of fitting a power plant to his glider, Lilienthal only intended to use it in emergencies—that is, when he would be unable to derive sustentation from the wind.

What Is Soaring Flight?

By soaring flight is meant the kind of flight practiced by the larger species of birds (albatrosses, vultures, eagles, hawks, buzzards, sea gulls, etc.) which consists in progressing through the air without any apparent expenditure of energy—that is, without the flapping of wings. Certain birds soar in this manner for hundreds of miles, and the albatross is said to follow steamships for days without ever flapping a wing when no wind is observed near the surface of the sea. There may be a certain amount of exaggeration in this statement, for soaring birds are known to flap at times; but it is a fact that this maneuver is engaged in only occasionally, probably when the wind veers, and the bird is forced to tack, so to speak.

It is generally conceded that the soaring birds derive the power of sustentation from the wind, for the great majority of observers are agreed that no soaring flight ever takes place in a dead calm. On the contrary, it seems that the higher the velocity of the wind, the more extended and regular are the "flapless flights" of the most perfect soarer—the albatross. This also appears to be borne out by what we know of the structure of the atmosphere, namely, that the velocity of a wind generally increases with height, for the best soarers habitually fly at great heights.

Structure of the Soaring Birds

If we compare the structure of the various soaring birds, we notice that the greater the ratio of the wing spread to the length of the body—that is, the slenderer the wings are, the better is the soaring ability of the birds. It may be noted, incidentally, that the birds which are incapable of soaring, and which propel themselves through the air by flapping their wings, all have a much smaller spread length ratio than even the poorest soaring birds.

The wing shape of the various high capacity soaring birds does not differ materially among them, except that the sea birds do not as a rule possess the highly sensitive hook-like tip feathers which characterize the land soarers. Land soarers generally extend their wings either horizontally or at a slight dihedral angle above the horizon, while the sea birds hold their wings arched downward like a bow. Both of these differences may be due to different atmospheric conditions prevailing over the ground and over the sea—about which we as yet know very little.

It is worth noting that the most capable soaring birds are by far the heaviest birds in existence, so that the ability to soar seems to depend to a certain extent upon a mass, or momentum, whereby the bird acquires and retains initial velocity when there is no wind. This assumption is plausible on the ground that the larger bird has a greater inertia per unit of surface area, since the mass of the body increases as the cube of the diameter, whereas the surface increases only as the square of the linear dimensions. The fact that the albatross is a much better soarer than the sea gull—the former being the much larger and heavier of the two—seems to justify this theory.

Finally, there appears to be a distinct relation between the size and shape of the body of soaring birds on one hand and their wings on the other. That the body is so shaped by nature as to produce the most even "flow-off" of the air stream which strikes the bird is self-evident, judging by what wind tunnel experimentation has taught us about the value of streamlining in reducing parasitic resistance. But aside from this it is quite possible—as some soaring experimenters claim—that the body of soaring birds is so shaped as to direct the wind upon a particular portion of the wings, whereby the bird is enabled to derive the maximum efficiency from soaring. Whether this hypothesis can be proven or not remains to be seen, but the question seems worth investigating in a wind tunnel.

The most generally accepted theory of soaring flight is that two sources of energy are available for its accomplishment. One consists of the so-called ascending air currents—that is, winds blowing on a rising slope; the other source is furnished by rapid changes in the speed and direction of the wind.

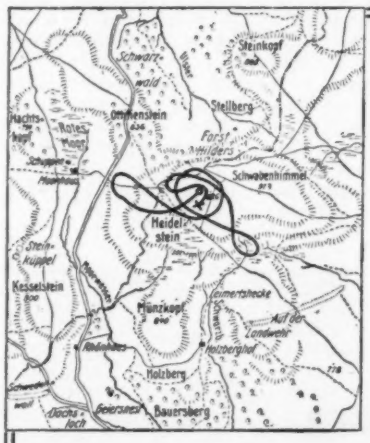
The Schwerdt soaring machine, which has hawk-like wings and is most attractive in appearance

Ascending Air Currents

Ascending air currents, or "upwinds," are frequent in any uneven country when the wind is blowing, for every natural obstacle in its path—a hill, a sand dune, a wood, etc.—deflects its course in an upward direction. In addition, upwinds are also created, although on a much smaller scale, by the uneven absorption of solar heat by the ground, due to different coloring. Thus, a certain portion of the ground, by absorbing more heat than the portion adjacent, will create a rising current, while as a natural reaction a descending current will occur over the colder portion. If this process is multiplied many thousand times, it will become apparent that the atmosphere, like the ocean, is more or less in perpetual motion, although to the observer on the ground it may appear to be in a state of calm. Our perception of this motion is undoubtedly far inferior to that possessed by birds, who seem to have the faculty of "seeing," or rather sensing, the flow of air—if the continuous head movements of soaring birds is taken into consideration.

Over the sea ascending air currents are created by the wave motion, each individual wave giving the air an upward deflection. From this it is easy to understand why the best soaring birds are *sea birds:* over the sea upwinds of some strength must almost continuously occur because the underlying medium is never entirely still, whereas in the case of land it is chiefly the shape and coloring of the earth which determines the existence of upwinds.

In addition to all this, upwinds are also created by meteorological conditions, such as cloud formations, from which the complexity of the question will be appreciated.



ON December 17, 1903, Wilbur Wright succeeded in making at Kitty Hawk, N. C., the first controlled power flight in the history of the world. For five years the incredulous world laughed at the idea, and branded the Wright brothers as imposters. On September 13, 1921, Herr Harth, a German aeronautical experimenter, on a motorless soaring machine, rose without any outside assistance from an absolute standstill to a height of 200 feet, and flew in all directions for 21 minutes and 37 seconds. The accompanying map shows the course followed by Harth on his soaring flight, the starting point being indicated by a circle, while the landing point is indicated by a cross. But the map tells only part of the story: it does not indicate that Harth, following his remarkable soaring flight, landed at a point only 40 feet lower than the altitude of his starting point. Here, indeed, is a remarkable achievement and, like so many others now being realized, must make for a new era in aviation characterized by low-power planes and an all-round raising of aero-dynamical standards. It is this phase of aviation, together with a study of the flight of soaring birds, that we asked Mr. d'Orcy to treat.—THE EDITOR.

How the Birds Soar

However, careful observation of soaring birds shows that upwinds alone do not produce soaring flight. When a soaring bird starts to "take off," he generally runs head on into the prevailing wind, flapping his wings until he meets an upwind, when he begins to describe circles. This circling flight of soaring birds is probably due to the limited extent of upwinds. In his ascension the bird still flaps occasionally—to trim sails, so to speak—but less and less so as he rises, probably because soaring conditions improve with height. When the bird has reached a certain altitude, he changes from circling to rectilinear flight, soaring with the wings rigidly extended.

From the above it appears that the soaring bird uses ascending air currents for being lifted from the ground, but once he has reached the height favorable for soaring, he must obviously emerge from this region of up-

wind which, as we have seen, is of limited extent. What then continues to support the bird and furnishes besides propulsion while its wings remain motionless?

That, indeed, is the great problem of soaring flight, and none of the available theories gives an entirely satisfactory answer to it. We have said before that in addition to upwinds a source of soaring energy is believed to exist in the irregularities, or rapid changes in speed and direction of the wind. When these fluctuations are of great strength, the bird is supposed to utilize them by presenting the greatest possible resistance to a gust, and the least resistance to the ensuing lull. In this manner the bird equalizes the wind fluctuations, for every time it "takes" a gust it increases its energy by an amount equal to that which the wind loses, so that it stores up energy in a gust, and spends it in a lull. Of course, such a maneuver means the sacrificing of speed for height (in a gust), and of height for speed (in a lull), so that according to this theory the soaring flight of birds would consist of a series of undulations. This maneuver may be observed at times, but it is the exception rather than the rule with the best soarers, who are capable of flying straight like an arrow—hence there must be a flaw in this theory.

The "Secondary Fluctuations" of the Air

But there exists another theory, of rather recent date, which affords a much more convincing explanation of how birds soar straightaway when they emerge from the region of upwind. It has for some time been assumed that the air particles which make up the substance of the wind—that is, of a given volume of air in motion, are continuously in a state of a very fine vibration which is similar in principle to the wave-like motion underlying the structure of many other physical manifestations (sound, light, electricity, etc.). Rumpler, the German airplane constructor, claims to have measured these "secondary fluctuations"—as he calls them—with a fine instrument, and to have found fifteen pulsations per second, or 900 per minute.

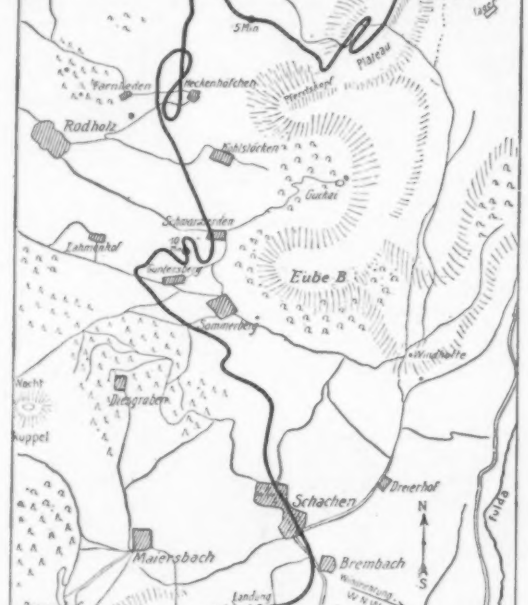
If this statement is borne out by further experiments, it is conceivable that these secondary fluctuations are the real source of soaring power, for they may cause the feathers of the bird's wings to vibrate and thus exert propulsive energy. Such a means of propulsion would be similar to that obtained with the so-called "fish tail" propellers, whereby the waves of the sea have been experimentally utilized for the production of power. This arrangement consists of series of flexible plates which are rigidly attached with their leading edge to the sides of a ship. As the waves rise and fall, the plates bend like the tail of a fish, and produce power both on the upward and the downward bend.

Requirements of Soaring Machines

So the principal requirements for a good soaring machine become clear. This should be a glider, or motorless airplane, having the slowest possible rate of descent, which means an extremely light wing loading (1.5 lbs. to 2 lbs. per square foot at the most), combined with high lift wings. It should be noted that a slow rate of descent and a flat gliding angle *are not synonymous*, for if two machines have the same gliding angle, and one requires a higher flying speed for its sustentation than the other, then the faster machine will naturally descend faster over the same gliding angle.

Considering only the assistance of upwinds and gusts for soaring (the utilization of "secondary fluctuations" being at present out of the question) to keep the machine in level flight, the speed of the ascending air current must be equal to the sinking speed, or rate of descent of the machine. Hence the smaller the rate of descent, the better chances has the machine of remaining in level flight, or of gaining height through gusts in the manner of soaring birds, and of capitalizing the resultant energy in the lull which succeeds the gust.

The question of head resistance has of course an important bearing on the efficiency of soaring machines. At the second German soaring contest, held last summer in the Rhön hills, near Frankfurt am Mein, two



Map showing the course followed by Klemperer in his Aachen soarer, between the Wasserkuppe and the village of Gersfeld, covering a distance of six miles in 13 minutes 3 seconds. In this flight the machine rose 300 feet above its starting point, and it landed 1560 feet below the latter's level. The direction of the wind, as well as the elapsed time in minutes, is indicated on this German map

An interesting soaring flight made by a German experimenter

soaring machines, having the same wing area, and one representing the very best in streamlining, and the other quite the opposite, obtained the same rate of descent *—but the streamlined machine carried an additional load of twenty pounds.* The soarers referred to are the "Aachen" and the "Bavaria," which are shown in the accompanying illustrations.

It will be seen that the "Aachen" soarer is a thick wing cantilever monoplane of the type developed by Prof. Hugo Junkers of Dessau, which has been introduced in this country under the name of J. L. metal monoplane. The machine is built of plywood in the form of girder work, and is covered with waterproof fabric. It is of extremely light weight despite its compact appearance and great strength, the wings weighing only one-third of a pound per square foot of area. The "Bavaria" soarer, on the other hand, has no streamlined fuselage, the tail being connected with the wings by outriggers, while the pilot sits on an underslung seat. The general appearance of this machine is reminiscent of the open-body pusher airplanes of some ten years ago. Yet at the second Rhön soaring competition, last August, the "Aachen," piloted by W. Klemperer, and the "Bavaria," piloted by Karl Koller, were tied for first prize in the contest for lowest rate of descent, both making an average of 80 feet per minute. The long distance contest was won by Arthur Martens on a Hannover soarer by covering 2½ miles in 5 min. 5 sec. His machine follows modern airplane practice in its construction, being well streamlined, but the fuselage is underslung with respect to the wings.

Without going into unessential details of the last Rhön competition, the following points seem worth recording for the guidance of those interested in soaring experiments:

1. The competition took place in a country where upwinds and gusts are frequent. The machines started from the top of the Wasserkuppe, a hill which rises to an elevation of 3000 feet in a plain bare of trees and free of natural obstacles in all directions. Under these conditions, eminently favorable for soaring, a wind of 18 to 20 m.p.h. generally proved sufficient for the purpose, but some contestants went up in winds reaching 30 to 40 m.p.h. This, notwithstanding, out of 120 individual flights made there occurred but one fatal accident, and this was due to a structural defect of the machine in question, so that soaring does not seem to involve an unduly large amount of risk as is generally supposed.

2. The soaring machines which made the best performance in the different contests all followed straight airplane practice as to structure and control surfaces. The more radical designs all failed to qualify in the elimination trials, which required the pilots to make a gliding flight of at least 1000 feet distance or one of 30 seconds' duration. It seems that too many new ideas were embodied in many soarers, so that piloting became very difficult and the machines had no chance of demonstrating what they were actually worth. One such machine, the Zeise, was equipped with auxiliary power in the form of small flapping wings which the pilot was supposed to operate by means of two pedals when the wind would be insufficient to keep the machine aloft. The principal characteristics as developed by the best German soaring machines are given in the table on page 237.

3. For launching the machines into the air two systems were successfully used in connection with the skid landing gea. with which the best machines were equipped. If the wind was strong enough for soaring, four men would get hold of the wings and slide the machine along the ground until it lifted—which would generally occur in a few yards. With light winds which would not lift the machines off the ground, the soarer was launched by a sort of catapult from a runway treated with soap to make for easy sliding. In this case six or eight men were required. Two of these held the wing tips, while two or three were at each end of a long rope which passed around the rear end of the skids, where it rested in a groove. Portions of rubber strands were incorporated in this "rope," and to launch the machine the men at the ropes walked forward until these strands were fully extended. Then at the pilot's signal, the men at the wing tips let go, and those at the ropes jumped forward to give the soarer a last pull. With this launching device the machine was often in the air after sliding three or four yards, when the rope would automatically detach itself from the skids. Once in the air, the pilot would start climbing in a series of steps corresponding to the wind gusts.

4. Most of the breakage occurred at the first trial of the various machines, partly because of the unfamiliarity of the "handling party," but chiefly owing to faulty construction of the landing skids. The experience of the Germans shows the importance of giving the skids a parabolic form so as to enable the pilot to "pull up" the machine as soon as a gust hits it, and so derive from it maximum lift. If the gust is very violent, a soaring machine can thus take off without outside as-

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The soaring machine of the Bavarian Aero Club, which is fitted with variable incidence wings, being piloted by Karl Koller

sistance. With machines on which the incidence of the wings can be changed by the pilot (the Bavaria soarer, for instance) the use of curved skids is less important.

Some Remarkable Soaring Flights

As a conclusion to this review of progress in artificial soaring flight the most remarkable performances which have been made to date will be related. All of these occurred after the second Rhön competition.

On July 30 Klemperer (Aachen soarer) flew across country from the Wasserkuppe to the village of Gersfeld, covering a distance of 6 miles in 13 minutes 3 seconds. In this flight the machine rose *300 feet above its starting point*, and it landed 1560 feet below the latter's level. The accompanying map shows to what extent the pilot was able to control the flight of his machine, making clever use of the upwinds impinging against the hillsides.

On September 6 Martens (Hannover soarer) beat Klemperer's record by making a duration flight of 15 minutes 40 seconds from the Wasserkuppe to the village of Botten, a distance of 4.6 miles. This gives a rate of descent of 84 feet per minute as against 119 feet for Klemperer's previous flight.

While these performances strongly appeal to the imagination, it is none the less a fact that considering the rate of descent of the machine in question, their performances cannot be considered as true soaring flights, but merely as very extended glides, the more so as each flight took place in one general direction. Hence a certain amount of doubt was justified with regard to the possibility of achieving true soaring flight with the available type of machine.

This doubt is, however, no longer warranted, since on September 13th, 1921, Herr Harth, an investigator of soaring of ten years' experience, succeeded in making a flight of 21 minutes 37 seconds' duration with a difference in height between his starting and landing points of only 40 feet, which gives *a rate of descent of less than two feet per minute*. This truly amazing performance, which did not receive the world-wide attention it deserved, is an undeniable demonstration of the fact that soaring flight can be achieved with the present aeronautical equipment. In other words, soaring is possible without the mechanism that would have to be invented to reproduce the vibration of the bird's feathers under the influence of the secondary fluctuation of the air—always assuming that this phenomenon is the main source of energy of the bird's soaring flight.

While no photograph of Harth's soarer has yet been published, a general idea of what it looks like may be had from the following particulars: The machine is a monoplane of 33-foot span and 165-foot wing area, and weighs 100 pounds. The pilot is seated underneath the wings in a lattice framework which extends aft and carries the tail. The latter consists of an elevator only, for the rudder which was originally fitted to it has since been dispensed with, as the machine was found to be more maneuverable without it. Instead, changes in horizontal direction are effected by the use of movable wing tips.

Harth's partner in soaring enterprise, W. Messerschmitt, has given the following account of Harth's great flight:

"On the day of the flight, September 13th, the wind was blowing in strong gusts with frequent changes in direction at an average speed of 22 miles an hour, which would at times suddenly increase with hurricane force to twice that strength. Heidelstein Hill, from which the start was made, reaches 2725 feet above sea level, but the slope of the hill to windward is only two or three degrees above the horizon, followed by slightly steeper slopes (four to six degrees), which in their turn end in a flat plain extending for several miles, after which there occurs again a very flat slope.

"Harth first made a few flights up to six minutes' duration *without any loss in altitude*, and as the wind strengthened he decided to attempt a much longer flight, and reach, if possible, greater heights than before. At the same time he saw the feasibility of letting the machine rise into the air without outside assistance, merely by utilizing the strong gusts. This he succeeded in doing, and once off the ground he began climbing into the wind until he reached a height of 200 feet. He then made a half turn and flew with the wind back over his starting point, whence he flew a circular course all aróund the hilltop, then out over the lowlands. After a while he turned about and flew back over the hill, and describing two half turns in opposite direction he landed 40 feet below and about 500 feet from his starting point.

"As the flight was made over practically level country, Harth is of the opinion that ascending air currents had nothing to do with it, and that he actually soared with the help of the wind fluctuations. He noticed, by the way, that the speed of his machine varied considerably when it flew against the wind, and that it always rose on turns, while it did not seem to lose any altitude when flying with the wind. He also states that the machine remained perfectly steady in the midst of gusts, and he attributes this fact to the use of movable wing tips which are made to head automatically into the wind and so keep the machine on its flight path."

Messerschmitt's concluding paragraph is perhaps worth reproducing. It reads:

"Our object, motorless flight of sufficient duration, seems now to have been attained. Messrs. Harth and Messerschmitt have for the last ten years made systematic experiments with wing surfaces capable of automatically turning into the wind *(anpassungsfæhige Tragflæchen)*. The results recently achieved prove that there exists now a soaring machine which can easily be flown for any length of time in the most squally weather without requiring from the pilot any physical effort."

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The Aachen soarer, piloted by W. Klemperer, shortly after its "take-off"

CHARACTERISTICS OF THE LEADING GERMAN SOARING MACHINES

Make	Span	Length	Wing Area Sq. Ft.	Wt. Empty Lbs.	Wing Loading Lbs. to Sq. Ft.
Aachen.....	30′ 8″	19′ 9″	162	143	1.87
Bavaria.....	36′ 4″	13′ 3″	162	123	1.74
Hannover.....	41′ 6″	17′ 2″	172		
Harth.....	33′		165	100	1.57

Note.—The wing loading given above refers to the machine fully loaded: that is, with the pilot on board. The weight of the pilot is assumed as being 160 pounds.

For purposes of reference it is interesting to compare the characteristics of the German soaring machines with the *aviette* on which Gabriel Poulain twice flew a distance of 33 feet (in opposite directions) on July 9, 1921, near Paris. This machine was a very light bicycle which was fitted with a biplane cell of 20 feet span on the upper wings, and 13 feet 4 inches on the lower wings, and having a wing area of 130 square feet. The net weight of the Poulain *aviette* was 37.4 pounds, and its maximum flying speed was estimated at 25 miles per hour. The wing loading, with a 160-pound pilot, works out as 15.1 pounds to the square foot, or about 10 times that of the Harth soaring machine.

The Significance of Harth's Flight

Although the latest advice from Germany is to the effect that Harth was unfortunately injured in a fall of his soarer, this accident does not in the least decrease the value of his truly extraordinary demonstration. No doubt even Harth's soaring machine is still far from perfect, and a considerable amount of experimenting will have to be done before soarers become fool-proof.

In the meantime, here is a field of practically unexplored human activity which offers a chance of turning flying into a real sport, one comparable, though on an infinitely superior plane, to sailing. Individual skill and prowess could assert themselves in soaring to an extent undreamed of in power flight where, after all, the roaring Liberty or its hissing minor brothers always have the last word.

What the practical advent of soaring will eventually mean to power flight is still a matter for speculation. That it will lead to a more thorough knowledge of the atmosphere, and so be the cause of improvements in the construction of airplanes, seems likely. It may perhaps also improve our notions of piloting. Finally, it is probable that vastly improved soaring machines fitted with an auxiliary engine of very low horsepower will eventually solve the problem of the aerial flivver. They won't be extremely fast, but they will be cheap and economical, and so within the means of anybody who can afford to keep a Ford. And they will carry you anywhere without the hazard of getting stuck in a jam at cross-roads or of running into a ditch on a dark night.

Here is an opportunity for Americans to do some pioneering work. Will someone heed the call?

Biological Effects of the Tides

FRINGING every continental land-mass is an area, for the most part very narrow, which belongs properly neither to land nor sea, but is the disputed province of both these realms. Although, on a superficial view, it is by no means favorable to life, the tidal zone turns out, on closer examination, to be one of the richest in variety of animal life on the surface of the globe.

Whether life began in the open sea or in the shallow waters of the littoral or in fresh water pools, scientists have not been able to decide. Nevertheless, one thing is certain, namely, that if life did not originate in the tidal zone nor in the area immediately below it, as some still think possible, then life was not very long in reaching there. It is unnecessary to adduce special proof of this statement: the vast number of invertebrate animals that frequent or have frequented, or that have relatives on the shore, from sponges, through coelenterates, echinoderms, worms, crustaceans, and mollusks up to ascidians, allows of no other conclusion. In its earlier youth, then, life served an apprenticeship to the tides, and it is probably not too much to say that life is continuing to show the effects. That is what biologists intend to express when they speak of the shore as the school wherein many of the most important lessons of life were learned.

As illustrating this there is the influence of wave-impact on the life of the seashore. This is at once made apparent to the observer, not only by the large number of fixed forms, of which the rock-barnacle is a prominent example, but also by the tendency even among free animals to keep a grip on the substratum. The adhesion of barnacles is due to a cement substance secreted by special glands in the region of the head, but in the case of sea-anemones, flat-worms, sea-slugs, and sea-snails, adhesion is due merely to an exceedingly close contact of the body with the substratum. A very interesting adaptation to life in the area of wave-action is seen a fish called the lump-sucker, which has the pelvic fins converted into a cup, or sucker, with which it clings to rocks and weeds. Mere adhesive powers are, apparently, not sufficient, since there is a tendency also to adopt a form which offers the least possible amount of resistance to the water, and, in particular, to reduce height. Shore forms are typically flattened forms.

The conclusion must be reached that the tides have not only been of very great importance in molding the present day life of the seashore, but have also had far-reaching consequences to life in general. This pulsing, ever-changing strip of the earth's surface has played a part in life out of all proportion to its size.

Our Point of View

Invention the Master-Key to Civilization

SHALL we be very far wrong if we place the inventor at the top of the list of men and things that have made the civilization of today what it is? Personally, we do not for one moment hesitate to do so. And this does not mean that we fail to recognize how much humanity owes to science, medicine, philosophy, finance, morals, and religion, which, by utilizing the works of the inventor, have made them conduce as much to the mental and moral as to the physical well-being of mankind.

Let your thought travel back to prehistoric times, to the day when man, possessing only the faintest glimmerings of intellect, had little more than hand and foot and teeth with which to compete with the beasts of the forest, most of which had more of speed and strength and cunning than he. What was it that started him on his upward climb to superiority but the use of his dawning intellect in the invention of weapons with which to turn this unequal conflict in his favor? One of the earliest great inventions, if not the very first, took place when someone cut a strip of tough skin, strung it tautly between the ends of an elastic stick, and fashioned the first sharp-pointed arrow as a missile. Thereby did invention overcome brute strength; and thenceforth, by similar applications of reasoned thought to the substance and properties of things, has man progressed in building up the complex and altogether marvelous civilization of our day.

If the importance of a man is to be judged by the extent and duration of his achievements, it cannot be denied that, in the presence of our old friend the inventor, all the kings, princes, emperors, statesmen, and soldiers of history, sink into relative insignificance.

Not to Alexander, or Cæsar, or Charlemagne—not to Aristotle, Cicero, Dante, or even the great Shakespeare—not to a Talleyrand, a William Pitt, a Cavour, a Gladstone, a Jefferson, or a Webster—not to the long line of brilliant men who have graced the law and the church—not to these do we owe the locomotive, the steamship, the automobile, and the fast flying ships of the air; agencies which have unlocked the immobility of man and made fluent the age-long solidity of the world. Not to these men, who are writ so large on the page of history, do we owe the printing press, the telephone, the telegraph, the wireless, and all those means by which no sooner do the thoughts of men germinate than they are flashed around the world—not to these men, but to real, honest-to-goodness, imaginative, painstaking inventors, such as Guttenberg, Faraday, Newcomen, Watt, Symonds, Fulton, Stephenson, Morse, Marconi, Pasteur, Edison, Langley, Wright, and a thousand others, who have always stood, and ever will stand, in the very van of the advancing hosts of civilization.

Now, this is a fascinating theme, and it has lately been handled most delightfully by one of the inventors of America, a man who has done as much, as an inventor, in the development of the United States Navy as any single man of whom we know. We refer to a book which has just been placed in our hands, entitled, "Invention the Master-Key to Progress," which has been written by Rear Admiral Bradley A. Fiske, who, in sending us a copy of his book, asks us if it does not "demonstrate that the whole structure of civilization is a machine, built up by inventors." We think that, with due acknowledgment of the important cooperation of science, religion and discovery, the statement of Admiral Fiske is essentially true.

Moral of the Washington Theater Tragedy

A FEW weeks ago the roof of a theater which was being built in Brooklyn fell, killing a score of workmen. More recently the roof of an important theater in the city of Washington fell, causing the death of ninety-eight people, including many well-known residents of that city. In both cases these horrible disasters seem, so far as the evidence has gone, to have been due to a combination of faulty design and careless inspection. We are free to confess that, so far from being astonished at disasters of this kind, we have been surprised that they were so long in coming, and that more have not happened. They are the logical and inevitable outcome of certain modern conditions, the perils of which should be shouted from the housetops, for the warning of that unsuspecting public which, as these ghastly tragedies have shown, may at any moment become the victims of the conditions.

We refer to the constant stream of so-called qualified architects and engineers, which issues yearly from our technical institutions, the members of which, equipped with no practical field experience, and furnished with nothing more substantial than the formulas and theories contained in their notebooks, proceed to hang out their shingles, and thereby advertise themselves as competent in their various professions.

Let it be understood right here, and very clearly, that we do not refer, specifically, to the authors of these wrecked structures, for we have no wish to prejudge their cases; we are casting no, nor would we cast any, aspersion upon the great body of engineers and architects taken as a whole; among whom are men as gifted and as well informed as to the past and present of their art, as any of the notable men who have made these professions famous. Our strictures are confined to the half-baked beginners, who, instead of associating themselves in a subordinate capacity with their seniors of ripened experience, hire a desk and open an office, and so proclaim themselves competent to undertake any job whatsoever, from the building of a Hudson River bridge to the erection of a Woolworth Tower.

Now, what has been taking place in the professions has happened also in the various trades having to do with heavy construction, and notably in the art of building. Today, any ambitious young carpenter, mason, or ironworker, growing scornful of the weekly pay envelope, is free to break away and set up as a master-builder. Some of these are men of real competence and ultimately make good; the majority of them were never gifted by the Creator with the resourcefulness, breadth of view, experience or executive ability, which are necessary to make a really competent contractor. However, there they are, and they are out to get contracts. What is the result? We have on the one hand the ambitious young architect, anxious to secure enough to pay for board, clothes, and office rent; and, on the other hand, we have the mechanic, now dignified with the title of contractor, who simply has to get contracts by hook or by crook, or suffer the humiliation of going back to the régime of the weekly pay envelope.

Well, human nature is sometimes very fine, sometimes very bad, and more often somewhere between the extremes; but the temptation on the part of the embryo architect is to skin down his construction as closely as he dares to the limit of safety, and the temptation for the young contractor is to beat the plans, by still further reducing the weight of material and the quality of construction that goes into the job.

That the above statement of conditions is not overdrawn is proved by the amazing evidence given by five army and navy engineers at the coroner's inquest into the Washington theater disaster, who found no less than twenty-one evidences of weakness in the structure.

Thus, *tile walls*, according to the Washington dispatches were used to carry a heavy concentrated load. Just think of that! There was no column to receive the load, nor was there even a pilaster where the main truss rested upon the wall. Apparently this tiling was left hollow, for there was "an absence of concrete fill" at the point of bearing, and there were no bearing plates on the wall. The steel, we are told, was insufficiently anchored to the wall. Finally, not only was the tile not hard burned, but it had scant webs and walls, notably at the top of Columbia Road wall, where the collapse took place. Moreover, in this wall there was insufficient bonding between the front and back tiles. If these findings are correct, it is little wonder that the additional snow load brought down such a wretched contraption.

Orphans of the Road

THERE are always two viewpoints with regard to changes in the design of an established product. On the one hand we have the man who is always striving for something better—even if it be but a little bit better. Opposing him we have the conservative who holds that changes should come slowly, and only after they have proven themselves conclusively. In practice the latter view is backed by the exigencies of manufacture; a million dollars' worth of factory machinery cannot be scrapped in the interest of a thousand-dollar improvement in the product.

For several years we have assumed the automobile industry to be in this conservative class. We look to the makers of our cars and trucks for gradual shifting of design rather than wholesale reversal of opinion. For we had supposed that, save for grudging accommodation to new conditions like fuel deterioration, the modern automobile was pretty much a finished product, not susceptible to sweeping changes.

It is with mingled emotions that we pass from these considerations to a recent announcement detailing the "improvements" in a certain car for 1922. Without being too specific, we can say that these involve, among other things, radical changes in the lubrication, the carburetor, the intake manifold, the radiator, the fan belt, the clutch, the torque member, the braking, the gear ratio, the springs, the rear axle, the front spindles, the steering gear, the frame, the body, and the fender.

Our first impulse on reading this catalog of "betterments" was to look up the concern and see how long it had been making automobiles. It would seem that in the six years of their corporate life, these gentlemen might at least have decided what kind of car they want to make. The tale of their "improvements" for 1922 is told with gusto, apparently in the hope of impressing the reader with the atmosphere of progress. We wonder just what the owner of last year's model will think when he learns the extent to which his car has been reduced, overnight, to a bundle of obsolescent junk. Shall we picture the plight of the service station that tries to keep a complete line of parts for all models, and to identify the particular one needed for inclusion in the repair of a 1919 specimen; or shall we infer that the service station will frankly leave the owner of such a car marooned, and tell him, as so often is done, that they can't be bothered with his job?

The thing has its humorous side which cannot be ignored; it has also its serious side. Everybody will agree that among the hundreds of cars on the market, there are and always have been a dozen or perhaps a score that stand out above their competitors as the cars to own. There might be controversy regarding the make-up of this group; of its existence there can be, we think, none.

Is not the reason for the persistence of this class of old reliables the fact that, with very minor modifications, these cars *are* the same, year after year? The ability to get a car right in the first place—the balance to keep it right thereafter: are not these the things that give us confidence in designer and builder? The production, every twelve months or every two or three years, of a model which can be recognized only by the nameplate as the successor of its predecessor: this was good automobile designing fifteen, even ten, years ago. Today it is a confession of weakness.

The fact that a given car enjoys an abnormally slow depreciation in turnover value, the fact that used models five and even ten years old command an active market, means an actual saving in dollars and cents to the buyer of such a car when he comes, at some future date, to trade it in. The practice of other makers, of admitting more or less candidly in their advertising matter

Our Point of View

and in the chatter of their agents that previous models have carried serious weaknesses, or have been of poor caliber throughout, but that *this* year's car is the one they are selling *now*—this leads to equally strong presumption that such saving will be absent when the time comes to dispose of a car of this sort. But far more important to the user than any specific saving is the knowledge that, under a verdict rendered by the automobiling world, his car will be current and serviceable and repairable after a long period of use, while the other fellow's will in a year or two suffer from the presumption of obsolescence, present questionable serviceability, and pretty certainly be repairable only at excessive cost and extreme inconvenience.

A Call for Cooperation

IF ever there was a call for close cooperation in the solution of a great and difficult problem, it is in the matter of reorganizing the transportation and terminal facilities at New York. As the traffic through the port has increased, the problem of properly handling it has loomed up year after year, with ever growing importance. Unhappily, the city fathers (and this means Jersey City just as much as Manhattan and Brooklyn) never realized that such provisions in the way of piers, warehouses, handling machinery, railroads, and so forth, as they were from time to time providing, were in the last analysis merely make-shifts, destined sooner or later, and rather sooner than later, to become obsolete and unequal to the task imposed upon them.

More serious than this, however, was the failure of the city fathers to appreciate the vast magnitude of the problems of the future. They failed to see that the time was swiftly approaching when, if the mighty flood of traffic which was destined to pour through the port of New York, was to be properly controlled, it would be necessary for all the interests served by the port of New York to get together and formulate a program of action which should be marked by foresight, directness and above all by unity of spirit and purpose.

It was in tardy recognition of these facts that the states of New York and New Jersey finally did get together and form what is now known as the Port Authority, and gave it instructions to gather all available statistics, and employ the best engineering and financial talent to formulate a plan covering the total situation. This has been done and the plans have been published and very widely discussed.

Briefly stated, the port plan seeks to link up all the railroads which enter New York City, by means of a belt line which shall touch every one of them, and enable freight that comes over any western or other road, to be switched on to the belt line and carried directly to that part of the port where the consignee—ship, factory, market, or merchant—may happen to be located. The proposed Port Authority belt line extends, on the Jersey side, parallel to the Hudson River, and about a mile distant therefrom, and extends by tunnel below the upper bay to a junction with the Long Island railroad system in South Brooklyn. The Long Island and the New York Connecting Railroad continue the belt line through Brooklyn and across the East River by the Hell Gate Bridge, to and through the Bronx, reaching the Hudson River again at Spuyten Duyvil. To serve Staten Island, the belt line will utilize the route of the Central Railroad and the Baltimore & Ohio over which, by means of the bridge across the Arthur Kill, the system will reach the new city docks at Stapleton, Staten Island.

Now, the existing city government, under its present redoubtable Mayor, professes to be very much disgruntled with the Port Authority plan. The Mayor believes, or professes to believe, that the Port Authority plan is merely a gigantic political scheme to "develop the Jersey meadows," or do some other malevolent things for the benefit of New Jersey and to the detriment of New York City. Personally, we do not believe anything of the kind; and we are convinced that any intelligent person who looks at the city plan and the Port Authority plan will feel that any suggestion of ulterior purposes of this kind is altogether uncalled for, being without a shadow of foundation in fact.

The readers of the SCIENTIFIC AMERICAN have already been made acquainted with the city plan, in an article published in the SCIENTIFIC AMERICAN for January, and written by Colonel William J. Wilgus, Consulting Engineer of the Board of Estimate and Apportionment. This plan, it will be remembered, differs from the city plan mainly in two things; first that the belt line starts on the Jersey side not far from Piermont on the Hudson River and intersects the incoming western railroads at distances of from ten to twenty-five miles from the waterfront. The line sweeps through New Jersey, finally reaching Perth Amboy, where Arthur Kill is crossed on a high level viaduct. Thence the belt line passes through Staten Island, on which a large classification yard is to be located. It serves the city's new piers at Stapleton, and then tunnels beneath the narrows to a connection with the Long Island and connecting railroads, thus forming a complete belt line.

Manifestly the sensible thing for the Mayor and his associates to do is to cooperate with the Port Authority, abandon its campaign of innuendo and obstruction, and set about honestly to to work with the states of New York and New Jersey for the benefit, not of its own political aspirations, but of the eight millions of people in the Port District whose combined interests it should be the highest object of the Mayor to serve.

Fruits of the Safety-First Movement

WE are told by the Interstate Commerce Commission that not since the year 1898 have there been so few railroad fatalities in the United States as were recorded in the year which closed December 31, 1920, the last year for which statistics have been compiled. Had this fine record been made during a period of railroad prosperity, when funds were plentiful and materials and labor reasonable in cost, it would have called for strong approval; but the year 1920 was one of the utmost heartbreaking discouragement for the railroad management, in which the most drastic economies had to be practiced. Not only did high wages render it necessary to work the railroads with depleted forces, but the high cost of materials necessitated postponement of orders for rails, ties, ballast, and other materials that were sadly needed to keep the railroads in first-class condition.

The number of persons killed on our railroads in 1898 was 6859, and the number injured was 40,882. In 1914 the number killed was 10,302, the number injured 192,662. In 1920 the total had dropped to 6958 killed and 168,308 injured. Now to appreciate the full meaning of this record, it must be understood that between 1898 and 1920 the passenger mileage increased from 13,000,000,000 to 47,000,000,000, or over 250 per cent, and there was an increase in the number of employes from 874,558 to 2,074,971, or 160 per cent.

In analyzing the tables given by the Interstate Commerce Commission many interesting facts are developed. Thus, of the total of 6958 killed during 1920 nearly one-half were trespassers on the railroad tracks, a fruitful and altogether unnecessary source of loss of life. Of such over 4000 were killed. The next largest figure is that for employees, of whom 2578 were killed. The majority of these losses occurred in freight traffic, and that they are so large is to be attributed too often to the independence of the employees and their lack of a strict sense of discipline. In these days of automatic brakes and automatic couplers and the activity of the Safety-First Movement, the fatalities to employees should be very much less than they are. The total number of passengers killed was 229, of which 76 were lost in train accidents, and 153 in train service accidents. It should be noted that the fatalities to passengers were about the same in 1920 as they were twenty-two years before; but the record is much better than it looks on the face of it; for we must remember that passenger traffic has increased in that period 254 per cent; similarly, although the number of employees increased 160 per cent, the fatalities increased less than 32 per cent.

Referring again to passenger fatalities, it is notable that only five times in the thirty-five years covered by the statistics of accidents were there fewer fatalities of this kind. In spite of the struggle which the railroads passed through in the endeavor to cover expenses, taxes, and rent, they carried over 47,000,000,000 passengers one mile with only 76 fatalities in train accidents. To put it another way, over 622,000,000 passengers were carried safely one mile, to one killed.

If the above figures fail to convince anyone that railroad travel has become a very safe means of transportation, let him consider the following fact: that 293 railroads, which embody nearly one-half of the total mileage of the United States, operated throughout the year 1920 without the loss of a single passenger.

The 1921 Naval Annuals

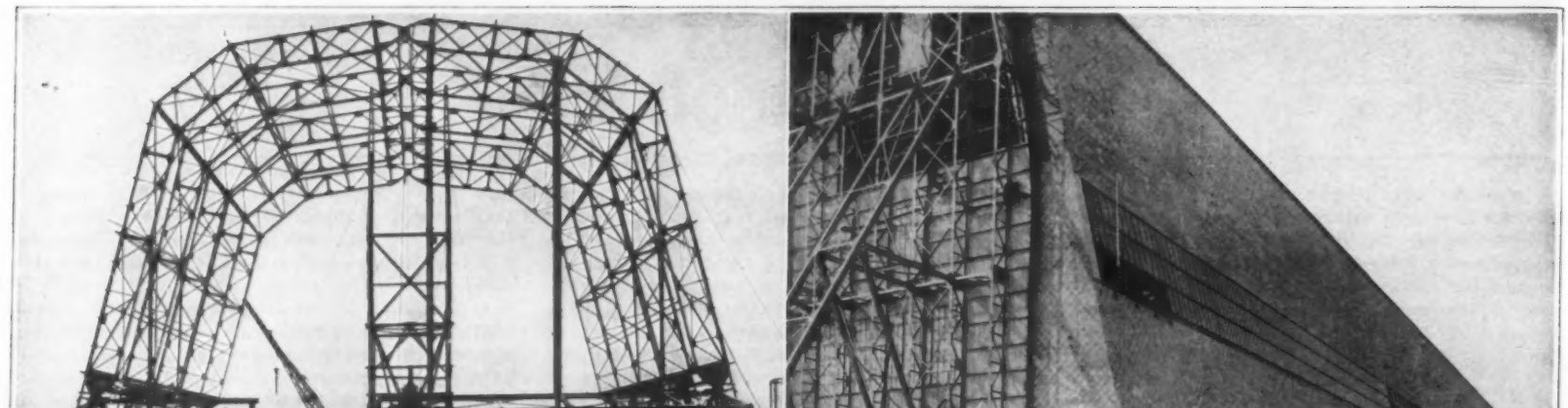
TO a naval man the names "Jane" and "Brassey" are as familiar as the terms "wind" and "weather." The Annuals bearing these names are sources of naval information which have become indispensable to the naval man and to the thousands of laymen who take an intelligent and patriotic interest in the Navy and Merchant Marine. The latest editions of these works, covering the year 1921, are larger and more packed with carefully selected facts and figures than any of the preceding volumes.

The new "Brassey" includes all the characteristic features of the earlier volumes, such as the detailed tables of the ships of the various Navies; the admirable line cuts of the principal types of ships; and the Ordnance tables. A large part of the work consists, as of old, of articles written by leading experts in their particular fields; but the list of these is now greatly extended, and they contain a mass of carefully digested and up-to-date information, representing the latest school of thought on the various questions discussed. The excellent plan, instituted last year, of including a section on the Merchant Marine, is continued, and this part of the Annual is fully up to the quality of the Naval section.

Although it is a younger publication, "Jane's Fighting Ships" is an even more voluminous work than the other, and as much as 635 pages, measuring eight by twelve inches, are required for the presentation of all the engravings, tables, and various data. "Jane" contains some features which are absent from "Brassey," just as "Brassey" is stronger in, let us say, the fine series of articles by technical experts referred to above. Special features in "Jane" are the pages of silhouettes, by which any ship of any navy may be recognized, and the very valuable series of scale maps showing the dockyards, and principal harbors of the naval powers.

The bulk of the work, as usual, consists in detailed illustrations and descriptions of every ship of importance in the navies of the world. This information includes the particulars as to displacement, armor, armament, speed, etc.; an outboard profile and a deck plan, showing the armor and armament; and one or more photographic reproductions of each ship. The airplane views of ships, which are shown very freely, will be valued for the information they convey regarding the deck, superstructure and bridge arrangements of the capital ships that are thus portrayed.

Particular interest attaches to these latest issues of the now famous Annuals because of the fact that they will constitute a last record of the stupendous size to which navies, and particularly the capital ships of navies, had grown under the competitive system. The Annuals for the next year doubtless will contain the famous Disarmament Treaty, and will show in their pages what a drastic reduction it has made in the size and cost of modern navies.



Left: **Re-erecting steel framework of old hangars upon side wall of A-frames to form new and loftier hangar.** *Right:* **New hangar completed, showing portion of front sliding doors and one side. Total length, 710 feet**

Making Two Dirigible Sheds into One

THE growth in the size of dirigibles rendered some of the earlier hangars too small for their accommodation. This was the case with two identical hangars located respectively at Montauk, N. Y., and Cape May, N. J. Each of these was 250 feet in length and 72 feet 6 inches in height. The framework consisted of three-hinged, framed steel arches of 122 feet 3½ inches span, which were spaced 20 feet 10 inches apart from center to center.

The Navy Department decided to take down these two hangars and use the materials in constructing a larger shed, which would have the same width of 122 feet 3½ inches between end pins, a width over all of 156 feet, a height of 110 feet clear at the entrance, and a length of 710 feet.

The two hangars were taken down, the steel work of the Montauk hangar being shipped to Cape May. To obtain the desired height, two parallel lines of steel A-frames were erected for the full length of the new hangar, and upon these frames was erected the steel work of the two dismantled hangars. At one end the hangar is closed by sliding doors, and at the other end a lean-to 16 feet by 22 feet extends the full width of the hangar.

As showing the economy which has been realized by this system, it may be mentioned that each of the old hangars contained about 350 tons of steel, and of this, 284 tons from one hangar and 238 tons from the other were utilized in the larger structure.

The A-frame bents, which are 44 feet in height, rest upon reinforced concrete foundations, which are carried upon wood piling. Two parallel rails, 90 feet between centers, extend through the full length of the hangar and extend out 1000 feet into the landing field. Between these rails run the trolleys which are used for guiding the airship from the landing field into the shed.

The building is sheathed externally with asbestos shingles laid upon wood planking. The lofty sliding doors are covered with corrugated asbestos. The doors slide laterally upon steel tracks, and they are stiffened and held in the vertical position by the inclined steel framework, which is shown very clearly in our engravings.

With the completion of the Cape May hangar, the Navy Department now possesses two dirigible sheds available, capable of accommodating the largest airships. The other is the new shed at Lakehurst, which has been already described in the SCIENTIFIC AMERICAN. For our information and photographs we are indebted to Rear-Admiral F. R. Harris, Public Works officer at League Island. The hangar was built for the Navy by the Bureau of Yards and Docks, and the field work was in charge of Lieutenant-Commander J. N. Laycock, U. S. N.

Dismantling old hangar. The frames of this and a similar hangar at Montauk were used in building the roof of new 710-foot hangar at Cape May

Four-Footed Transatlantic Passengers

HOW many people realize that the service in ocean travel so admirably rendered to men, women and children by a great steamship company like the Atlantic Transport Line, the American Line, the Red Star Line, the White Star Line and Leyland Line is duplicated in essential features for four-footed passengers as well?

Each of the lines mentioned has special facilities for taking our four-footed friends on ocean voyages; so that horses, pet stock, cattle or other live stock are just as readily transported by steamer as human beings, while the matter of obtaining bookings for your favorite horse, or for a consignment of horses or other animals, is no more difficult than making a reservation for yourself and your family.

It is not to be assumed, however, that the four-footed travelers make their ocean voyages in the same ship as yourself. They have ships of their own, as carefully fitted up to meet their needs as your ship is to meet yours.

Ships known as live-stock carriers are specially built for that purpose. First of all, they must be big, broad ships that will ride steadily in the sea, with minimum rolling; for "sea legs" are not easily acquired by four-footed passengers.

The ship specializing in the carrying of animals must also be fitted with specially designed and constructed stalls for horses, special pens for cattle, and so on, the comfort and safety of each kind of stock calling for a certain type of equipment.

Further, the liner for four-footed passengers must have facilities for special ventilation. Our four-footed friends are used to outdoor life, and to freely ventilated stables or barns. It would not do to shut them up in a dark, poorly ventilated space at sea.

Again risk of injury must be avoided when the four-footed passengers go on board the ship or leave it. Hence large side ports, like great swinging doors, are built in the sides of the live-stock liner, from which ample gangways can be fixed, enabling the stock to walk on or off the ship on a gentle grade, without risk of stumbling. The great hazard of injury attending the old hoisting method of handling cattle is entirely avoided in the modern live-stock ship.

It is quite obvious that the successful live-stock steamer, owing to the requirement of stability, must be of the freighter type, with enough reserve power to bring the ship and her valuable cargo safely through all sorts and conditions of weather.

A visit to one of these live-stock steamers will surprise a person not familiar with their facilities for shipping live-stock overseas.

Entering by way of the specially constructed gangway or "brow," leading from the pier to the steamer, one passes through a large cattle port and steps directly upon the live-stock deck of the steamer.

The first impression received is one of amazement at the cleanly spaciousness of the place, the absence of obstructions and the presence of an abundance of pure fresh air circulating systematically through the entire length and breadth of the steamer.

Here will be found any sort of live-stock accommodation which may be desired—horse fittings ranging from the 2-foot 6-inch stalls for commercial horses to the 10-foot padded box stalls occupied by the aristocrats of the equine world; also hundreds of 10-foot cattle pens, all neatly whitewashed and each designed to take care of four animals.

Overhead will be found the fresh water supply system, with hose connections and water tanks at regular intervals along the deck. Under foot there are numerous scuppers to insure the perfect drainage so necessary to the comfort of the animals. Peat moss and sweet straw are used for bedding.

Electric lights are installed throughout, and the effect of the whole is that of a large, well-kept, up-to-date stable.

A Pump-Power Railroad

How Gravity, Through Water-Filled Tanks, Draws Passengers Up a German Mountain

By Andrew Goobeck

SITUATED on the left banks of the historical Rhine where the American soldier has been walking post since the signing of the armistice, 18 kilometers from Coblenz, the headquarters of the American Forces in Germany, lies Andernach, the second oldest city in Germany and the oldest on the Rhine. Founded in the days of the Romans about 12 B. C., it was one of the 50 forts built by Drusus along the river and the headquarters of the 21st Roman Legion, with ruins of the old walls still partly surrounding the city, which today is the headquarters of the Second Brigade of the American Forces in Germany.

Towering above the lower outskirts of the city and the river is a small, sheer mountain known as the Khranenberg, on whose steep incline is a narrow gage railway, built in 1895 by a private concern and successfully operated until the late European war broke out, causing it to remain idle until this year, when the city of Andernach acquired the management and is now running cars on schedule to Khranenberg Summit.

The railway, built to accommodate tourists and pleasure seekers, is about 550 meters long from the city to Summit Station, which is 120 meters above the former, the steepest part of the climb being midway where the rise in grade is one meter to every three meters of track. The mechanical operation of the tramway is very simple and economical. The rolling stock consists of two cars 8½ meters long by 2 meters wide, weighing 7 tons apiece. These are connected to each other by a 1½-inch woven-wire steel cable, which passes over a 10-foot-diameter iron guide-wheel underneath the platform of the Summit Station. One car stands at the summit when the other is at rest at the city station. Both the cars are fitted with a tank underneath the rear platform holding 6½ cubic meters of water and a glass gage alongside the rear of the car, spaced off in half-meter lengths to show the amount of water in the tank. Through a small manhole in the front of the car and a water spout on the station platform, water is taken by the car at the summit a few moments before departure, the amount taken depending upon the number of passengers in the car leaving the city. There is telephone communication between the two stations, installed for this purpose and for any other communication between the two operators of the two cars, who constitute the entire transportation department. A few moments before the time of departure, the guard on the up-going car calls the guard of the down-coming car, standing at the summit and tells him the number of passengers in his car. The man at the top of the line, having already counted the passengers in his own car, opens the valve on the water spout and takes the amount of water necessary to give the additional weight that will pull the up-coming car to the summit. The water in the down-coming car tank is automatically released the moment the car stops at the City Station, through two valves located underneath the tanks which come in contact with interference plates placed above the track. When both cars are empty 3½ cubic meters of water are required by the car at the summit to pull the empty car coming up. Each car has seating capacity for 24 persons and standing room on the platforms for 11. In event of a fully laden car departing for the summit and no passengers in the down-coming car, 6½ cubic meters of water are more than sufficient to make the trip. There are no springs between the body of the car and the frames, and what little shock may arise from the slow trip which consumes 6 to 8 minutes, is absorbed by hard rubber pads laid between the frame and body.

The cars are equipped with both service and emergency brakes. The latter may be operated from either end of the car by a simple rotary brake-rod operating a worm gear through a gear block, which through the brake levers applies the brakes to both cog wheel drums underneath the car.

The railway is of one-meter gage and single track, with a passing siding located in the middle of its course and is supported by iron ties in a rock bed which gives it a firm and solid foundation, the outside and cog rails being firmly bolted to the iron ties. The middle, or cog rail, which is used to give the cars brake resistance, is laid in short 2½-meter lengths in order that worn sections may be removed in short lengths.

The cog rail is of peculiar design, its cogs being about one inch below the double-flange girders on each side. This design aids in keeping the car on the track as well as furnishing resistance for braking. On each side of the cog rail and between the outer rails, about seven meters apart, are small guide pulley wheels over which the cable runs that is attached to the two cars, the cable of one car running over the right guide wheels, and the cable of the other car over the left guide wheels. The passing track being located at the middle of the course, the car with the right-hand cable takes its respective track and the car with the left-hand cable takes the left track, this being accomplished by the peculiar construction of the car wheels and their opposite arrangement on the two cars.

The car with the right-hand cable and which has to take the right passing track is equipped with double-flange wheels on the right side and plain or Mulley wheels on the left side, while the car wheels on the car with the left-hand cable are just the reverse, having double flange wheels on the left side and Mulley wheels on the right. The outer rails of the passing siding being unbroken, each car is guided to its respective side while the Mulley wheels pass over the inside rails and unbroken cog rail without any interference, as the wheels are rigid on their axles and run through very strong housings in the frame. The cog rail of course has to remain unbroken, or otherwise brake power resistance would be lost.

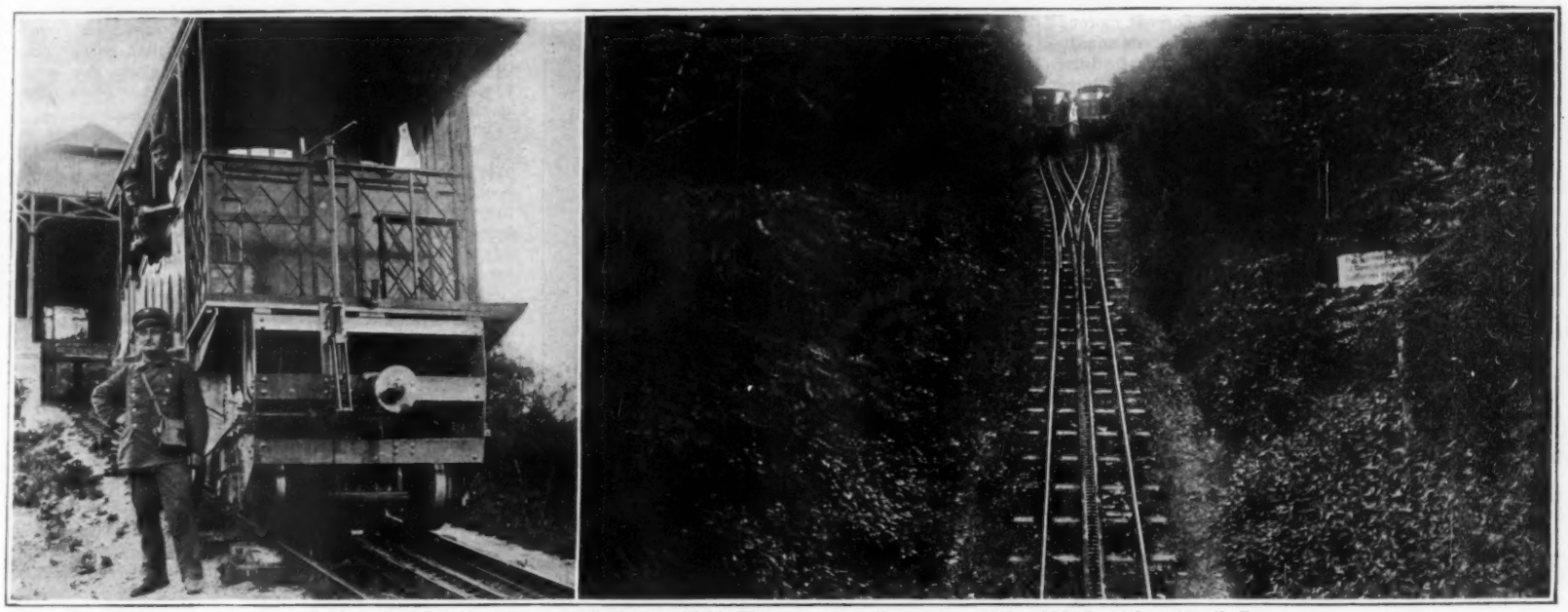
The cog wheels provide the cars with both service and emergency brakes, the service brake of either car being sufficient to stop both cars at any point in the course. Ordinary service braking is done by the guard of the down-coming car, who in this manner naturally regulates the speed of both cars.

Suspended at a 45 degree angle on a 3-foot lever at each end of the car on the left side are two 200-pound weights, one of which assists the guard in ordinary service braking, while the other remains at all times suspended on a small trigger slide, and is so designed that in case the cable breaks, both weights drop on both cars, stopping them instantly. The cable attachments are at the forward end of the cars at the lower end of a malleable iron rail swung on a swivel, with the upper end against a strong tension spring, which is compressed while the cars are in motion, but in case of the cable parting would throw back the rail, releasing a lever connection which drops both of the weights. There is also an emergency brake-lever which can be used by the guard in case of necessity to drop these weights and set the emergency brakes.

The water that is used for the filling of the gravity tanks on the cars is supplied from a large concrete basin, about 36 feet in diameter by 8 feet deep, which is located at a point higher up than the Summit Station, and is fenced in to avoid any refuse being thrown in. A pipe line to the Summit Station is large enough to fill the tank on the car in a few moments.

The water that is released from the car at the City Station flows into a 30-cubic-meter-capacity cistern, located underneath the platform. When this tank is nearly full, the water is pumped back through a pipe line to the basin at the top of the summit by a small centrifugal pump that is directly connected to an 11-kilowatt electric motor supplied by a 500-volt line and running 2000 revolutions per minute. This pump will empty the cistern in better than one hour's time.

By using only a sufficient amount of water to pull the up-coming car, very little power is consumed. On week days when traffic is light, two to three hours per day are all that the motor and pump are used. However, on Sundays and holidays when the traffic and schedule are increased to meet the demand, six to eight hours per day are required to keep the cistern emptied. As the water is used over and over again, very little water is required from the city supply, the only loss being what little is used to cool the braking system and through evaporation. The guards on both of the cars run the small motor and pumps and watch it while their car stands at the City Station, and thus the operating expense is reduced to a minimum.



Left: One of the cars at the summit station. *Right:* The two cars at the passing switch, which they take automatically

The gravity railroad up the Khranenberg, a mountain in the German Rhine country

Will the Direct Current Era Return?

Discussing the General Question of Oscillating and Rectifying Vacuum Tubes as Applied to Power Distribution

By Raymond Francis Yates

Schematic arrangement of the units used in generating and transmitting high-voltage alternating current, and then stepping it down and rectifying it into direct current at low voltage

BEFORE the days of Tesla's induction motor and his wonderful work on the application of alternating current, direct current reigned supreme. Pure necessity ushered in the alternating-current era and brought about a revolution in the electrical industry. Those of us who have watched the development of electron tubes have come to realize that there is at least a possibility that the present limited application of direct current will be greatly multiplied within the next few years. The suggestion is at least alluring and the many engineering developments that have taken place in vacuum tube work point out clearly the amazing possibilities that lie in this direction. Of course the writer does not mean to infer that direct current will crowd alternating current out of the field entirely; that would be nothing but the rankest kind of idle speculation. The fact to be brought out is this: Certain engineering difficulties now prevent direct current from being used where it is most needed. The application of the vacuum tube will overcome the obstacles that now interfere.

For certain work the direct-current motor is ideal in every respect. In steel mills the direct-current motor is most efficient for use on the rollers where continual changes in speed are necessary. Of course, alternating current motors may be used, and they are used, but their use is attended by a considerable wastage of power or by the complication of several added machines for each motor. The induction motor is most efficient at certain speeds and any decrease in speed beyond very definite limits brings about a great waste of power.

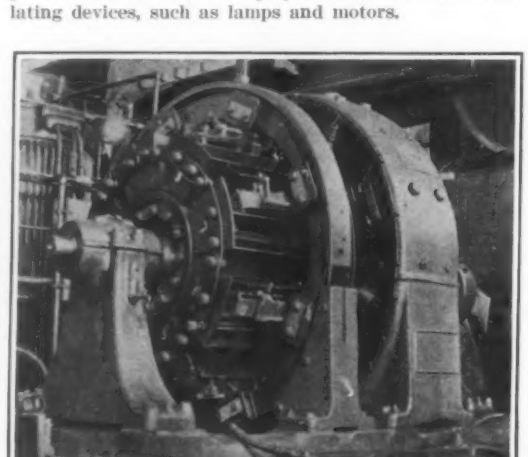
Although alternating-current systems are used to some extent in transportation work, the direct-current motor is the most suitable for this purpose. The Norfolk & Western, for instance, use single-phase alternating current with a phase changer in the locomotive which provides three-phase current for the driving motors. On the other hand, the Chicago, Milwaukee & St. Paul employs 3000-volt direct current for locomotive operation. The direct-current installation is by far the most efficient where widely varying speed is required. From the standpoint of engineering and from the standpoint of economy, the use of direct current in all transportation work is highly desirable.

Series street arc lighting systems operate most efficiently with direct current, and, of course, direct current is an absolute necessity in electrochemical work.

The layman will ask: "If direct current is best for these purposes, why not generate and use it?" Unfortunately direct current cannot be transmitted over great distances at low voltages without a great waste. Low-voltage current of any kind cannot be transmitted any considerable distance without appalling losses. The voltage of alternating current can be raised to practically any value through the use of transformers, and since voltage or pressure is necessary to overcome the resistance offered by the long transmission lines, alternating current is quite naturally used. In fact, alternating-current transmission lines are now in use with voltages in the neighborhood of 200,000. Direct current, owing to its nature, cannot be transformed, and certain engineering difficulties also present themselves in the generation of high-voltage direct current. To the writer's knowledge, the 3000-volt line on the Chicago, Milwaukee & St. Paul system is the highest voltage direct-current system used in this country.

Although all of our electric power is transmitted over long distances through the use of alternating current, this form of transmission is by no means ideal in every respect. The use of direct current would be much better providing its voltage could be raised to the proper value. The inductive effect of high-voltage alternating-current lines is extremely troublesome in many cases. It not only causes power losses, but also brings about trouble in adjacent power, telephone and telegraph lines. Further losses are brought about by the "skin effect," which has a retarding effect on the passage of the current that must be added to the ohmic resistance of the cable used. The capacity effects of high-voltage alternating-current transmission lines also causes fluctuations in the voltage.

Although none of the losses or disadvantages mentioned above occur in direct-current transmission, the limiting transmission pressure is fixed by the maximum pressure which can be employed on the various translating devices, such as lamps and motors.



It is held that the simple vacuum tube must some day replace elaborate rotary converters such as this

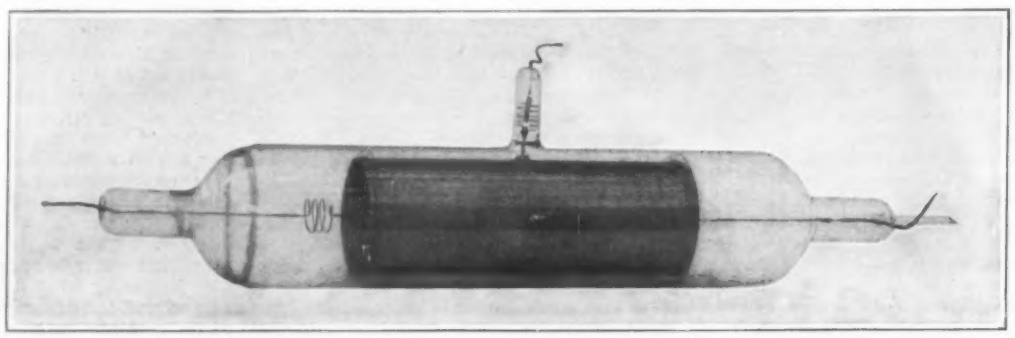
During the past few years a great deal of work has been done on vacuum tube devices, and it is the development along this line that makes the further application of direct current look so promising. The Kenotron tube, produced by the General Electric Research Laboratory, is a wonderful rectifying device. By this is meant that it is capable of rectifying or changing an alternating current to a continuous or direct current. Tubes may be oscillators as well as rectifiers—one is the converse of the other. (Oscillator tubes are used in radio work and require the Armstrong regenerative arrangement.) When work started along this fruitful line of investigation, tubes were made that would handle only a few milliamperes of current. Today tubes are made that are capable of handling several amperes, and before long it is said that they will be made to handle currents measured in kiloamperes. The efficiency of vacuum tubes is low when they are operated on low-voltage currents, but this efficiency rapidly increases as the voltage raises, and engineers today see no reason why tubes cannot operate with an efficiency as high as 99 per cent.

Will it ever be possible to install a battery of vacuum tube rectifiers on a locomotive and operate the motors with direct current from a high-voltage alternating-current line, or from a high-voltage direct-current line? This is a question that is interesting engineers at the present time, and there is a great deal of discussion regarding the matter. If such were the case, an electric locomotive could have all of the advantages offered by direct-current locomotion from an alternating-current line. The alternating-current line is not so desirable, since it causes telephone interference and must be single-phase, which is not as economical as three-phase.

The power sub-station offers another possible field for the application of the vacuum tube rectifier. Here it would replace the costly synchronous converters. A small battery of heavy current tubes placed on a rack would take the place of a machine that costs many times as much as the tubes. Moreover, the tubes would not need the constant attention that is required by the synchronous converter.

The use of vacuum tubes in the electrochemical industry is also possible. However, special conditions exist in this field, and the tubes that are being developed today could not be applied to this work, since they are essentially high-voltage devices and the electrochemical service calls for a low-voltage tube. Present-day tubes can be operated on comparatively low voltages, but the efficiency falls off rapidly. It is more than remotely possible, however, that a suitable low-voltage tube will be developed for this work. It may or may not be a vacuum tube. Perhaps it will be a vapor tube of some sort.

High-voltage direct-current transmission is the most interesting phase of the question to be considered. The use of a highly efficient tube for such work would bring about a large saving in line losses. At this point it might be well to quote Mr. Albert W. Hull of the General Electric Research Laboratory. "Twenty years will see direct-current transmission lines, fed through transformers and Kenotrons, at any convenient points by alternators of any frequency, and tapped by the same tubes, acting as magnetron alternators, or some equivalent Pliotron or combination vacuum tube alternator." In the future, then, will our substations contain only a few transformers and a rack full of vacuum tubes?



A 4 by 12 inch magnetron. The vacuum tube is capable of rectifying alternating current into direct current, and, conversely, can oscillate so as to produce alternating current from direct current

Specifications for China and Glass Tableware

FOR some time tests have been conducted by the Bureau of Standards of the chinaware commonly employed by hotels and restaurants with the idea of eliminating breakage and unnecessary sizes.

A meeting was held recently at which the U. S. Potters' Association was represented and considerable satisfaction was expressed by the makers of chinaware at the bureau's work. Offers of considerable additional ware for experimental use were received, and it is probable that the investigation will be extended to cover all varieties of this material.

All government departments have now accepted the tumbler specifications prepared by the bureau, and it is probable that these will be printed so as to make them more generally available. As considerable interest has been shown in the work, an article is being prepared which will be submitted for publication in several of the technical journals in the immediate future.

The Tomb of an Egyptian Queen

The Metropolitan Museum Scores Another Triumph in Finding the Sarcophagus of Aashait

By Albert A. Hopkins

A FEW months ago we described the beautiful and interesting miniature models showing Egyptian life, trades and customs which were taken from the tomb of Mehenkwetre and which produced the archæological sensation of the decade when they were put on exhibition. Now we can chronicle a find fully as interesting, but the tangible results will have to be deferred; for the plan of operation in Egypt is on what we usually call a "fifty-fifty" basis—that is, half the objects found remain in Cairo and the rest come to this country. This year the exhibits secured by exploration were so fine and important that they could not be so readily divided as could the models, where a miniature slaughter-house could be offset by a miniature bakery or brewery. The division is made in all fairness, but it goes by value, not quantity; therefore it was thought wise to withhold the material and divide it in a lump with the finds of next season.

It was very natural for the explorers to hark back to the same neighborhood which gave the valuable discoveries of the mummy of Prince Amenemhet in the Spring of 1919 and the models of Mehenkwetre in 1920; so the excavations in Thebes were resumed. The little valley in which they worked for two seasons is a weirdly romantic place, even for Thebes. There is little trouble from tourists, who seek the more spectacular ruins, and almost the only figure seen in the desolation is an occasional fox. Even in the days of remote antiquity this city of the dead was deserted, so that it is little wonder that thieves occasionally broke in. Our engraving gives an idea of the wild beauty of the desert area. The last picture shows the platform where over two hundred men and boys dug away the masses of rock and sand that had fallen from the cliffs and the little iron cars that carried off the débris. Leaving for the moment the more abstruse details of the eternal grind incident to archæological exploration, we pass to one of the actual finds.

Once upon a time there lived in Thebes, about 2000 B. C., a young queen who would look all right today with her bobbed hair and her pet dog sitting under her chair, but she passed away at the early age of twenty-two and was buried with all the pomp and circumstance of her exalted rank. She did not rest in peace, however, for sometime in the interval of 3921 years that elapsed thieves broke in and rifled the tomb. The violation of the tomb occurred about 1600 B. C. Mr. H. E. Winlock, the head of the expedition, describes the find as follows:

"The artists who fashioned the magnificent sarcophagus of Kauït now in Cairo—a piece of sculpture which has been taken as one of the classical examples of Middle Kingdom art ever since its discovery—made Aashaït's sarcophagus as well. It is a masterpiece of the sculpture of a school which was still archaic, but of a technical skill rarely equaled.

"On the east side is a representation of the palace doorway with the balcony above, from which Aashaït was supposed to look out upon the world through two graven eyes. Within the palace all manner of good things are heaped before her, while she sits with her dog under her chair and a maid behind her, fanning her with a duck's wing. She drinks milk which the dairymen give her fresh from a pair of cows that are

Aashait's coffin, as the inevitable thieves left it

brought in with their calves, or she visits her farm where her steward superintends the peasants carrying sacks of grain up into her granaries. Her maid gives her jars of sweet-smelling perfumes from the boxes in her closets, and her butchers slaughter an ox and heap a dinner-table mountain high before her. Inside, the same scenes are repeated in brilliant colors, for such were the events of her daily life and such were her hopes of the world to come.

"On the wooden coffin which stood inside the sarcophagus, the subjects of the decorations belong more to the mysterious realm of magic. Outside it is severely plain, with fine-grained wood relieved only by bands of gold along the edges, by deeply carven prayers, and once again the eyes which look out upon the world. Inside, all is of a weird brilliancy. The lid of the coffin is the sky and on it is painted an astrological almanac in tabular form, giving the rising of the stars and constellations through the twelve hours of the night, and a long prayer to the beings of the firmament. Our "Great Bear" we find masquerading as a leg of beef. Long magical texts cover the sides and ends of the coffin and above them are ranged in rows item after item taken from the catalogue of the amulets and talismans necessary to the soul that would escape the dangers and the pitfalls of the netherworld. The student of religion and magic will find here a wealth of data on man's ingenuity in inventing the jargon of mystery.

"Inside the coffin Aashaït's body had been laid in a mummiform cartonnage, which in spite of its wrecked condition is an important document on Egyptian mortuary customs. Over her had been piled masses of bed sheets to cover her in her eternal sleep and in the corners of them the explorers found the linen marks of the royal palace of four thousand years ago—sometimes simply 'King Mentuhotep' or 'The store of fine linen' or again the name of the steward who superintended its making or its acquisition. By her side had lain her statuette, archaically stiff, with gold bracelets and a red skirt held up by white suspenders.

"The thieves who broke into Aashaït's tomb had been looking primarily for precious metals and little had escaped them. A few beads from her necklaces, a shell bracelet of no value to them, and two silver bead anklets were all that they overlooked, but by good fortune during the four centuries she lay in peace, her jewels had left casts in her bandages, which time had not obliterated; and from them we were able to draw a diagram of all she had worn. To make room for their work, they had swept aside most of the offering pots and the joints of beef supplied for Aashaït's ghostly life, and they had broken the lid of the sarcophagus to get at her body. Beyond this, however, the sarcophagus, the coffin, and the statuette had suffered no material damage and all three have come down to us almost as fresh and clean as the day they were made."

Other coffins were also found to have been rifled. One of the finds in a big sarcophagus was a little white-washed wooden coffin of a child named Maït. Inside the explorers found a second coffin in which lay a pile of linen bed clothes covering the little mummy. There lay Maït with the eyes of her plaster mask gazing through the eyes painted on her coffins. While the coffins were small, the wrapped mummy with its mask

Left: Hauling the sarcophagus from its resting place. *Right:* Carrying Maït's coffin through the ruins of the temple

Metropolitan Museum workers engaged in a discovery of more than usual value at Thebes

was much smaller, and when the explorers came to unwrap it they found that, small as it was, it was mostly padding at head and foot to disguise the tiny proportions of the little infant within, which the archæologists called pathetic. The finery which she wore in her short life was all there, five necklaces in all. One was a string of hollow balls of gold; one was of carnelian; two necklaces of minute beads of silver, carnelian, green feldspar and rich blue glass; and finally a necklace of gold disks so fine that strung on leather bands they look like a supple tube of unbroken gold. The carnelian necklace was even preserved on its own string. Little Maît must have been a blaze of color four thousand years ago.

Archæology on a business basis: the light railway that is used in modern exploration of ancient building sites

Alaska Once Subtropical

THE ancient vegetation of the Arctic region, as is shown by a study of its fossil plants, indicates that its climate was once very unlike that which prevails there now. Instead of consisting of a handful of small plants struggling for life amid snow and ice in a scant, almost perpetually frozen soil, its vegetation was abundant and luxuriant and included ferns and palm-like plants that grow only in a mild and probably frostless climate. This vegetation flourished in the Arctic region from at least late Paleozoic to middle Cenozoic geologic time, millions of years ago, before man existed. Although these lands are now so inhospitable and are rarely visited, the United States Geological Survey has gathered a large amount of information concerning their fossil flora.

A study of the coal beds of the Cape Lisburne region has incidentally disclosed many fossil plants. These coal beds are extensive and are the only known commercially valuable mineral resources of that region. A little coal is occasionally mined for vessels that are short of fuel, which, as there is no harbor, lie offshore and perilously load on a few sacks of coal by means of lighters.

Cape Lisburne is the headland which marks the northwest end of a land mass that projects into the Arctic Ocean from the western coast of Alaska about 160 miles north of the Arctic Circle and about 300 miles directly north of Nome. Even Cape Lisburne is by no means the northern limit of the fossil plants of this nearly tropical vegetation, for they have been found in the rocks 180 miles northeast of that Cape.

Burning Up the Corn

An Emergency Measure of the American Farmer, and What It Means

By H. C. Hardy

THE Indian, who gave corn to the world, has a superstitious reverence for his principal food staple, and occasionally burned it as an offering to his tribal gods. But it has remained for the white man and his economic difficulties to make of corn a fuel.

Much has been made of the "crime" of burning food. The good people who argue that because human beings in Russia or the Far East are hungry, therefore to burn corn for fuel in this country is a crime, have their hearts located where their heads ought to be. It is no more a "crime" to burn corn for fuel than it is to burn coal to make electric light, instead of burning it to heat the house of people who happen to be cold.

Corn, like any other commodity, is valuable only in reference to its location. A farmer who possesses corn which is valued at $100 as food, but which can give heat equal to $150 worth of coal, is criminal not if he burns it, but if he sells it. For to make up the difference he would have to dispose of other food products, which, if he burns his corn, may either sustain him or be sent to starving Russians.

With the "crime" idea eliminated, let it be chronicled that the amount of corn burned in the United States has been grossly exaggerated by the newspapers, especially those which cater to people who carry their hearts on their necks and keep their heads in storage. Secretary of Agriculture Wallace made out the case for corn as fuel as follows:

Ear corn at 20 cents a bushel is equal in fuel value to a fair grade of western soft coal at approximately $10 a ton. In districts where corn is very cheap now the coal is usually of a rather poor grade and is selling at high prices. Under such conditions it will pay both farmers and people in country towns to use corn instead of coal.

"Because of the variation in quality of both corn and coal it is difficult to make scientific experiments the results of which are applicable everywhere, but, speaking generally, the relative heating values of corn and coal are about as follows:

"Corn at 10 cents a bushel equals coal at $5 per ton. Corn at 16 cents a bushel equals coal at $8 per ton. At 22 cents a bushel it equals coal at $11 per ton; and at 30 cents a bushel it equals coal at $15 per ton."

To be successfully burned, of course, corn must be dry—the drier the corn, the greater the heating value. Some farmers have burned shelled corn, but dried corn handles more easily and makes a hotter fire burned on the ear.

Burning corn is not new. It was done in the early history of the West when corn was cheap and coal dear; and in Argentina corn is burned not only on farms but in power plants. In any situation where the price of coal is largely increased by the haul from railroad to market, corn, at low market prices, becomes a fuel competitor. The farmer who burns his corn avoids the haul of corn to market and the rehaul of coal to home.

But on the other side of the problem stands the great American hog, who grunts disapproval of the use of corn as fuel. With corn selling around 25 or 30 cents a bushel it is better economy for the farmer to feed as much of his crop as possible to hogs, despite low prices of pork. Results of numerous experiments in feeding hogs on corn rations alone show that on an average about 10 bushels of corn can be expected to produce 100 pounds of pork. In experiments where other feeds, notably grazing crops, have been used to supplement corn results have been better.

With corn selling at 35 cents per bushel, pork can be produced, on this feed alone, at an average cost of $3.63 per hundred. At 40 cents per bushel, it should cost $4.15 to produce a hundred pounds of pork. If live hogs sell at 7 to 8 cents per pound, the farmer who feeds 35-cent corn and produces a hundred pounds of pork for $3.63 still has a pretty safe margin of profit. Another factor in this connection worthy of the farmer's consideration is that in feeding corn to hogs, approximately 80 per cent of its fertilizing value is retained on the farm instead of being sold.

The Department of Agriculture shows the importance of corn in the agriculture of the United States by figures for the decade 1908 to 1917. In that period the acreage devoted to corn in this country was 4.8 per cent greater than the combination acreage of the crops of wheat, oats, barley, rye, rice, buckwheat and flax. The value of the corn crop for the same period was 24.3 per cent more than the combined values of these crops. During the same decade the number of acres in corn was 18.7 per cent in excess of that for the previous decade. A growing increase in the price per bushel for corn is indicated by the fact that the value of the crop was about 100 per cent greater in the past decade than in the previous one.

Roughly, we plant a hundred million acres in corn and reap three billion bushels. Should the SCIENTIFIC AMERICAN make out of these figures one of its illuminating comparisons in which statistics are made to appear as pictures, it would have its artist draw a globe, and a wagon train crawling around it in nine and a half spirals, each wagon containing 50 bushels and each wagon occupying 20 feet of space.

It is obvious that no such food crop could be largely diverted to fuel purposes from the world's larder without so revolutionary an upheaval of the world's bill of fare as would make the highest of high war-food prices seem pre-warish by comparison. The fact that corn is still low-priced, and pork also, is sufficient evidence that no very great amount of corn is being fed to stoves and boilers. The best evidence of exaggeration is the fact that Uncle Sam's big farm agency, the Department of Agriculture, has no statistics on the amount of corn burned as fuel, and does not believe that the practice has been largely followed, in spite of the excellent advice as to its economy given by the Secretary.

Corn, of course, is primarily food. It may be of interest to recall that in this country it has also been used as money, Indian ornament, source of sugar, tax medium, ammunition among the early settlers when lead was lacking—and now as fuel. If the sentimentalist will undertake to lay down, at the farmer's door, some other fuel at a price that competes with the value to the farmer of his corn, you may be sure that what burning of corn there has been will cease. If corn-burning is something to be remedied, the remedy lies not in shedding tears about the starving Russians, but in raising the price of corn or lowering that of coal or wood or oil or something else that will make a fire. When other combustibles cost more at the farm than the farmer can get for his corn, it stands to reason that he will burn the corn—and he is right in burning it.

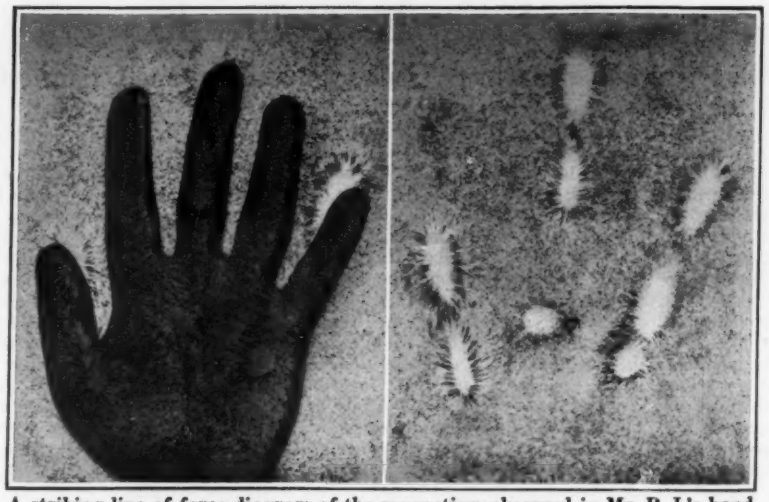
Even when we think in terms of the community at large rather than in terms of the individual, it ought to be pretty obvious that what makes fuel high to the farmer is the necessity of getting it to him; and that what makes corn low at the farm is the fact that it still has its transportation to buy and pay for. Transportation is today one of the most high-priced of all the commodities which go to make possible the civilized life, and one which we must, in the interest of all, economize at every turn. When the balance of prices is such as to lead the farmer to burn his corn, we may be very sure that one of the chief reasons for this condition is that we cannot, as a community, afford to give over our transportation facilities to the interchange of corn and coal between farmer and city. There may be some occasion for excitement in this condition, but the excitement should not be directed at the farmer, who, by burning his corn, is doing his share to meet the conditions and to make the visible supply of transportation go around.

Magnetism in Human Beings

By Dr. Alfred Gradenwitz

THAT some persons in every respect behave like living magnets, and that this behavior not only is closely connected with physiological and psychic phenomena, but opens up unthought-of vistas on the further investigation of body and soul, is the conclusion reached by Fritz Grunewald. This investigator has carried out a remarkable series of experiments on a Mr. P. I.—a gentleman personally known to the author, who, like Mrs. Ruf (examined, as far back as in 1867, by Fechner) is able with his hands to deflect the magnetic needle, his two hands generally showing opposite polarity.

That this action on the magnetic needle actually is to be ascribed to magnetical rather than electrical or any other effects, was shown conclusively; for on pushing his hand through a coil of copper wire, the person experimented on would induce there an electric current, indicated by the deflection of an ammeter connected with the coil, just in the same way as by pushing through the coil a magnet bar.



A striking line-of-force diagram of the magnetism observed in Mr. P. I.'s hand. The same diagram is shown, alone and superposed upon the subject's hand

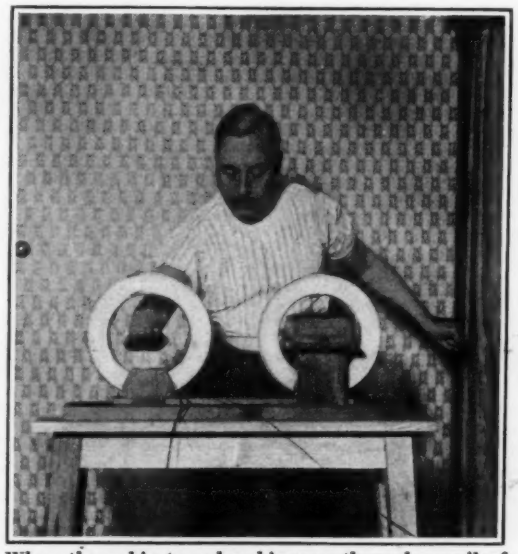
It was, of course, interesting to ascertain whether the will of the person would exert any influence on these phenomena. This was soon found actually to be the case. Mr. P. I., with his hand kept perfectly motionless, was able to alter the magnetic force and, accordingly, the current intensity, by as much as 10 per cent.

By examining the whole body of the person as to the presence of magnetism, Grunewald has been able so far to ascertain that the hands, arms and, temporarily, his head will exhibit magnetic properties. By means of iron filings spread out on a glass plate he has in the usual manner produced pictures of the lines of magnetic force. In several cases the existence of two poles, marked as bright spots on the remaining filings and from which the lines of force would spring forth, could be stated on these magnetic pictures above the person's hand. With an experiment made on the person in a hypnotized condition, Mr. Grunewald could even count no less than 14 different magnetic centers.

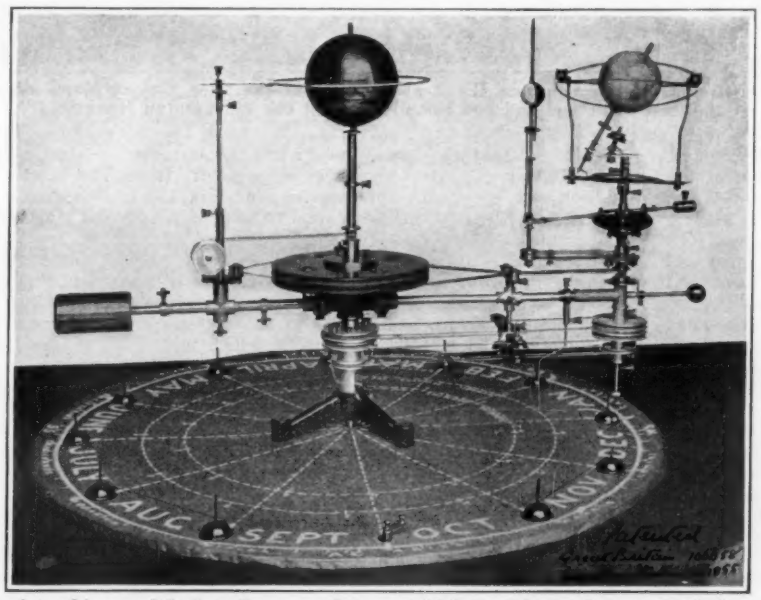
Especially interesting are the relations between magnetism and physiological phenomena, as discovered by the experimenter: The deflection of a magnetic needle arranged above the hand would undergo an alternation corresponding to the rhythm of breathing, increasing during inspiration and decreasing during expiration. Not less striking was the fact that the magnetism, which in the morning, immediately after getting up, showed a negligible value, would in the course of the day undergo an increase after each meal.

Though the existence of a vital energy as asserted by "magnetopathists" is as yet denied by most medical men, Grunewald would seem to have been the first to demonstrate in a palpable, objective way, by the use of his ballistic method, the existence of a vital energy transferable from one person to the other. In the case of 115 "magnetic" treatments carried out by Mr. P. I. since 1917, he was able to ascertain a decrease of magnetic intensity attending, it would seem, the giving off of vital energy. In fact, after such a treatment, lasting, as a rule, for a quarter of an hour, this intensity would drop to one-third of its initial figure, and in cases where Mr. Grunewald himself underwent the treatment, the most marked decrease would, strange to say, be noted whenever, previous to the treatment, he had felt especially weak, that is, had been especially in need of a supply of vital energy.

In order now to make sure whether the weakening of the action exerted by the magnetic needle is not simply due to the physical work yielded, Grunewald caused Mr. P. I. to perform a check test, viz., some sort of "blind" treatment, in connection with which similar strokes were made through the air. The result of this blind test was remarkable; the magnetic intensity (and accordingly the susceptibility to "magneto-therapeutical" treatment) so far from decreasing, having undergone a striking increase. In fact, Mr. P. I., as it were, had absorbed something like vital energy, an hypothesis confirmed by the fact that, *without knowing anything of the results of these measurements*, that is, without being under any suggestive influence, he would state that, on striking through the air, he had experienced an increasing resistance, with a strange consciousness of absorbing something. This result of objective tests involuntarily reminds one of the assertion made by Hindoos, that they for thousands of years have been in possession of the art of absorbing "Prana," *i.e.*, vital energy, from the atmosphere, by means of a special technique of breathing or gymnastics.



When the subject pushes his arm through a coil of wire, the magnetic force therein is sufficient to induce an appreciable current in the coil



A working model of earth, sun and moon, which reproduces the entire relative motion of these three bodies

A Mechanical Sun and Moon

MOST of us can, without actual reference to models or diagrams, get a very decent mental picture of any series of motions, so long as these motions confine themselves to a single plane. When the bodies in question abandon the plane and travel through the three dimensions of space, however, the fact immediately emphasizes itself that we are fundamentally a two-dimensioned race.

One case of moving bodies in space is that furnished by the earth and the two bodies that illuminate it—the sun and the moon. To understand the phenomena of daylight and darkness and moonlight at all properly—to say nothing of the seasons, the variation in length of daylight, and the other subsidiary matters dependent upon the rotation and revolution of earth and moon—the ordinary citizen is utterly helpless in the absence of a working model of some sort.

Such models are not to be bought in every hardware store—or even of every dealer in scientific apparatus. Their accurate design and construction call for a degree of care and skill not everywhere available; for to be of real value they must be working models, and in no sense "stills." They must show the course of the earth about the sun and of the moon about the earth; they must show clearly the successive phases of this complicated system.

The latest addition to the small family of models that do all this is illustrated herewith. It is designed and built by Mr. William Wilson of London. As a fair example of the difficulties inherent in such a piece of mechanism, we may remind our readers that if it were not for the inclination between the plane of the moon's orbit and that of the earth's path about the sun, the moon would be eclipsed every full moon and the sun every new moon. But, in the presence of the moon's orbital inclination, if its orbit were entirely fixed, we should have no eclipses at all! What happens is that the moon's orbit, taken as a whole, rotates about the earth, so that the point where the lunar track pierces the earth's orbital plane is now here, now there—and sometimes between us and the sun at the moment when the moon is at this point in her journey.

Description of the working parts of the model is superfluous so far as it duplicates the showing of the photograph, and we believe would be out of place if it went any further. It may be well, however, to state specifically that the model is driven by hand. The long bar which directs the "earth" in its course about the "sun" is rotated manually by means of the handle on its end, which also serves as a balance weight; and all the other motions of the model are derived from this by the several pulleys, etc., shown.

This model, unlike most of its predecessors, is not a mere curiosity; Mr. Wilson is actually manufacturing and selling them to schools, libraries, museums, etc. It gives a complete picture of the relation between year, month and day; the alternation of day and night; the succession of the seasons; the phases of the moon; the various forms of eclipse—lunar and solar, complete, partial and annular; and the Saros or cycle of 18 years 11 days in which the succession of eclipses recurs. In the abbreviated "years" and "days" of the model this cycle is just one day short—an error of one in 6600. Since the globe representing the earth carries a properly oriented map, it is even possible to follow the track of the eclipses, and note where they are observable.

Specifications for Window and Plate Glass

THE Bureau of Standards has recently tested a large amount of figured and wire plate glass, the results of the work showing great uniformity of the product. In general, the strength increases as the square of the thickness, as is the case with many other materials. Sufficient glass of each type is being tested to give an accurate and unquestionable average of strength for this class of material. Sufficient information has been gathered to warrant the calling of a conference of those interested during the month of January.

Curbing the Colorado

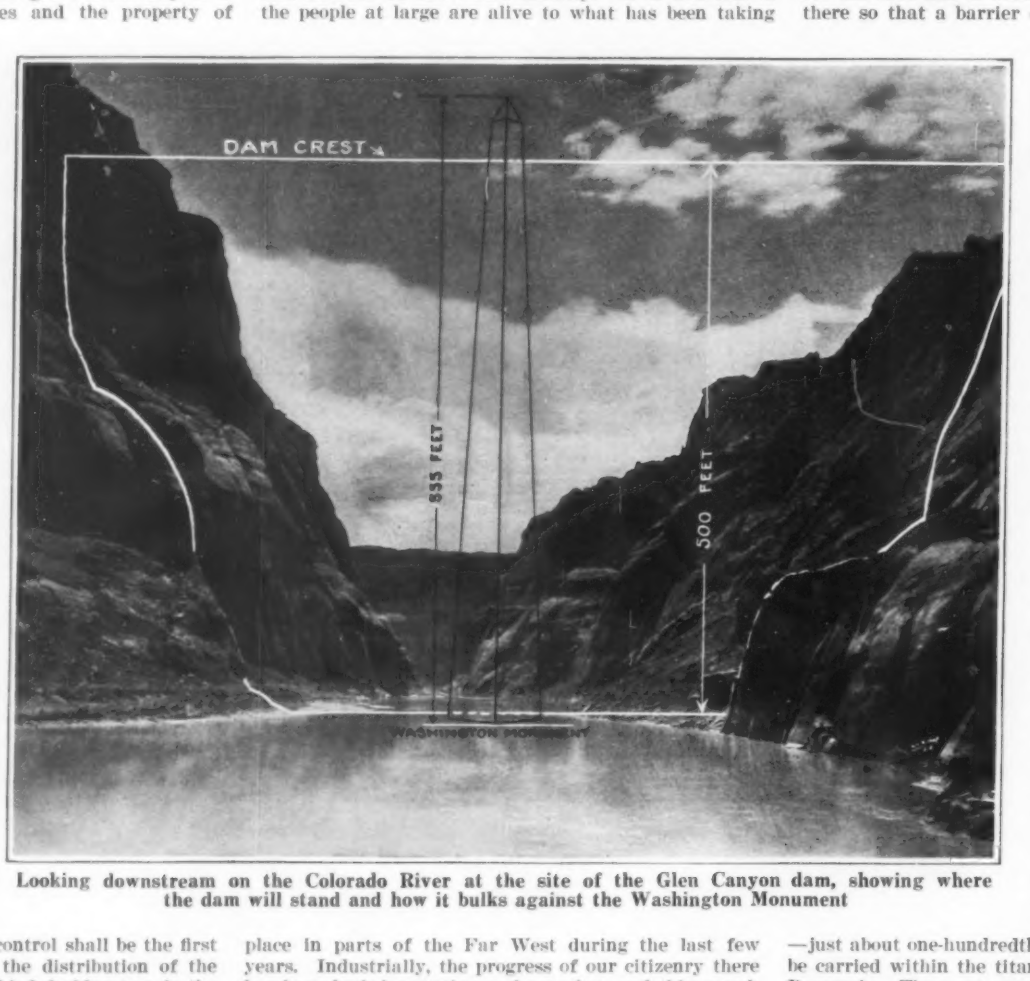
Flood Control, Irrigation, and Power Generation All In One Gigantic Construction

By Robert G. Skerrett

ALREADY, the electrical engineer has shown how the snows of the high Sierras can be transformed into energizing current distributable for hundreds of miles through a State which is notably deficient in deposits of power-producing coal. Similarly, this same technicist is busy planning ways by which the widely diversified flow of the second largest of our rivers, the Colorado, may be stabilized and utilized to operate a number of immense hydroelectric stations.

The Colorado River drains a watershed covering fully 250,000 square miles, and in the course of a twelve-month its run-off amounts to 16,000,000 acre-feet of water. The States affected by the movement of the Colorado are Nevada, Utah, Wyoming, Colorado, New Mexico, and California. Normally, the Colorado runs to extremes: in dry seasons it is low and its speed of travel comparatively sluggish, but when the melting snows and rains of the wet months pour their fullness into the far-flung basin the river becomes a raging, torrential stream capable of doing an enormous amount of damage. Uncontrolled, this great waterway is a continual menace to the lives and the property of dwellers in the Imperial Valley and in the adjacent lands, lying below the level of the sea and situated both in the United States and in Mexico.

Properly regulated, it is estimated that the Colorado can be harnessed so as to develop a total of 4,350,000 horsepower and, at the same time, be employed to make fruitful through irrigation something like 2,250,000 acres of otherwise arid soil. To this end the Federal Power Commission has granted a preliminary permit to the Southern California Edison Company to develop 2,500,000 horsepower of this block of potential energy. How, it will be asked, are nature's tremendous forces to be curbed to achieve these ends and a river of such might bridled so as to do man's bidding year in and year out? The answer is: by engineering boldness of a sort that staggers the imagination at first blush. The scheme involves nothing less than the rearing of a towering dam directly across the path of the waterway down in the depths of a canyon scoured out by erosive action during a period of thousands of years.



Looking downstream on the Colorado River at the site of the Glen Canyon dam, showing where the dam will stand and how it bulks against the Washington Monument

In view of the number of States concerned in any possible development of the Colorado, it is apparent that flood control shall be the first aim; the next consideration is the distribution of the waters for irrigation; and the third desideratum is the generation of electric power. The problem has been to devise means that would accomplish these results in the most effectual manner, in the shortest time, and with a minimum of outlay. Two projects have been under advisement for some time—the Boulder Canyon scheme, of the U. S. Reclamation Service, and the Glen Canyon undertaking which is fathered by the Southern California Edison Company. The dam contemplated by either of the interests would, so it is said, solve the flood control and the irrigation phases of the problem, but only one of them would permit the fullest utilization of the power resources of the river

As the profile diagram accompanying this article shows, Boulder Canyon is located close to the foot of the slope, and while a dam 600 feet high erected there would create a vast storage reservoir of sufficient amplitude to regulate the stream's flow the year through, still it is plain that power plants established below that dam would be the only stations that could profit by the head of water so formed. Indeed, the practicable head would be limited to that represented by the height of the dam itself, *i.e.*, 600 feet. On the other hand, a dam 500 feet high at Glen Canyon, well up toward the top of the slope, would insure a head for power purposes of over five times that—3100 feet. That is to say, a series of power stations could be built between the base of the Glen Canyon dam and the lowland, and each of them, successively, could use the descending waters to actuate groups of powerful turbo-generators. The plan of the Southern California Edison Company is, therefore, especially interesting because of its magnitude and what it promises in the way of the fullest development of the river's resources.

While the matter of power generation constitutes the third and last reason for bringing about the control of the Colorado River, this department of the problem is, nevertheless, one of the great economic importances inasmuch as it has to do intimately with the continued prosperity and productive growth of a section of the nation which projects its reflexes throughout the length and breadth of the whole country. It is doubtful if the people at large are alive to what has been taking place in parts of the Far West during the last few years. Industrially, the progress of our citizenry there has been both heartening and amazing, and this march forward has been due in the main to three agencies: a favorable climate; a soil ready to bear abundantly when irrigated; and a strikingly wide and varied use of electricity. The future of southern California, for example, is dependent upon hydroelectric developments on a gigantic scale if the region is to become the manufacturing and agricultural center for which nature's bounty has peculiarly fitted it. During the single year of 1920, the population of Los Angeles alone was augmented by 100,000, and this sudden increase of 17 per cent is in contrast to a cumulative expansion of but 6½ per cent annually during the preceding decade. In short, by reason of the diversity factor—the many services to which electric current is put, the annual demand growth is at the rate of 50,000 horsepower in that municipality and the territory contiguous to it. This block of energy is enough to take care of the needs of 300 factories, the irrigating of 100,000 acres of land, and to supply energy for numerous purposes to 32,250 residences. To effect this power development and to install the necessary distributive network of wires involves an expenditure of $15,000,000; and the total outlay, when house and factory wiring and the purchase of motors and electrical appliances are included, is approximately $45,000,000.

In these circumstances, it is evident that a steadily increasing amount of motive energy is indispensable to the well-being of that part of the United States which is doing so much towards transforming the commercial character of the Pacific coast. Therefore, the Glen Canyon project commands more earnest attention by all of us owing to the advantages which will ultimately accrue to the country at large through the consummation of this splendid engineering enterprise. In the end, the erection of the dam in Glen Canyon will do much to prevent a repetition of a shortage of power in California, such as was experienced in 1919, owing to the drought which then prevailed.

Glen Canyon is situated partly in Arizona but mostly in southeastern Utah, and the gorge at the point chosen for the dam site is 1800 feet deep. The walls narrow there so that a barrier only a few hundred feet from side to side will suffice to block the path of the waterway. With a height of 500 feet, as planned by the engineers, the dam will serve to create a reservoir northward for a distance greater than 200 miles, and thus accomplish the impounding of more than 40,000,000 acre-feet of water—*i.e.*, two and a half times the annual run-off of the river's watershed. As a matter of fact, the canyon is so constituted that it naturally would catch, when dammed, quite 93 per cent of the run-off; and by reason of its impounding capacity there could be held in reserve enough surplus water to neutralize a drought covering an interval of a whole year.

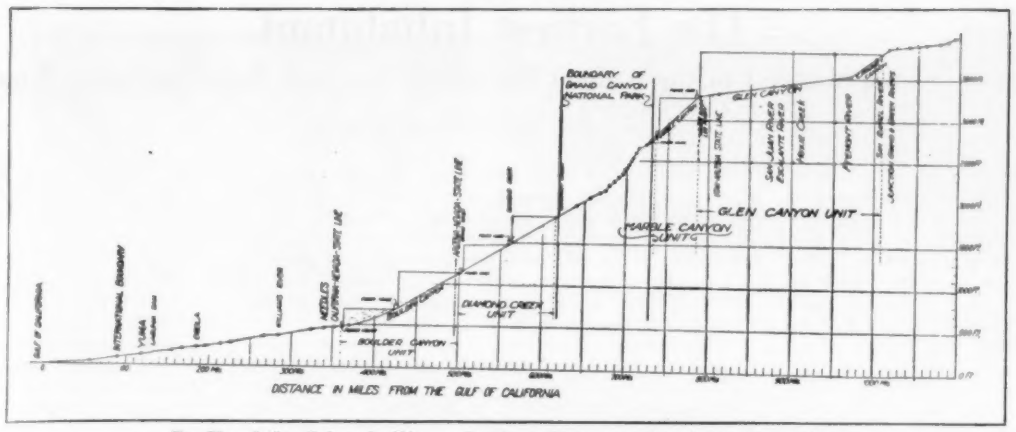
For the sake of those interested in comparative figures, let us see how this proposed lake of man's making looms up alongside other notable works of the hydraulic engineer. But first let us convert an acre-foot of water into the common term of gallons. An acre-foot is water overlying an acre to the depth of one foot, and this is equivalent to 325,829 gallons. The capacious Ashokan Reservoir of New York City's Catskill water supply system is capable of holding 132,000,000,000 gallons, or 405,120 acre-feet—just about one-hundredth part of the water that could be carried within the titanic basin of the Glen Canyon Reservoir. The next nearest approach in capacity are the artificially created storage facilities on the Nile, where barrages hold for deliberate distribution a total of approximately 3,500,000 acre-feet of water—not one-tenth of the amount that will be taken care of within the Glen Canyon reservoir!

We are assured that the rearing of the 500-foot dam at Lees Ferry will make it feasible to control absolutely the quantity of water discharged southward into the river's course, and that this volume at no time will exceed that which can be accommodated without fear of violence within the Colorado's natural banks. Therefore, the need of levees will be substantially eliminated. These defensive media have been costly expedients heretofore in the efforts made to keep the river within bounds and to prevent the inundation of large areas under cultivation.

As it exists today, the Colorado is virtually of no value for transportational purposes, and at times, for long stretches, is impassable. The Glen Canyon storage basin, on the other hand, will make 300 miles and more

of the river navigable. This will inevitably prove of prime value in promoting traffic and in stimulating industry where physical conditions now hamper intercourse. But let us get a more intimate idea of what the scheme offers in the way of greatly amplifying blocks of power.

Today, the flow of the Colorado ranges from a minimum of 3500 cubic feet per second to a maximum of about 200,000 cubic feet per second, and when the latter state prevails the stream's flow is substantially identical with that of the Niagara River. The drop of the Niagara River between its upper section and Lake Ontario is 300 feet in round figures, and of this head only 200 feet is utilized by the existing hydroelectric plants. On the other hand, there is a fall of 2600 feet on the Colorado River between the Glen Canyon dam site and Boulder Canyon, and, with the 500-foot head of the impounded water within Glen Canyon there would be available for power purposes a total drop of 3100 feet —more than 15 times the head today engaged in working wonders among the industries energized by the Niagara River. As matters stand, by international agreement, hydroelectric stations on the American side of the Niagara are allowed to divert for power only 20,000 cubic feet per second.



Profile of the Colorado River, showing all contemplated developments

The plan for the control of the Colorado River contemplates regulating its variable flow to a uniform one of about 18,000 cubic feet per second. This volume of water, in combination with the heads that will be available, at different points, will make it practicable to generate a far greater measure of electrical energy than is feasible at or contiguous to Niagara Falls. The motive force so developed can be distributed north and south, east and west, within a radius of several hundred miles —a potential of 220,000 volts to be employed to effect this. The current so available may be used to electrify existing steam railways, which would call for about 35 per cent of the total, and the remainder would be placed at the disposal of the farmer, the miner, the manufacturer, and the divers demands of towns and cities. It is computed that the hydroproduced energy would result in a reduction in fuel oil consumption of something like 90,000,000 barrels every twelve months. This is an item of national moment, now that liquid fuel has become more essential to the driving of our battle craft and the ships of our merchant marine.

The areas that will be benefited by the Colorado River project and draw electricity from the stations there will embrace three-fourths of California, all of Arizona, Nevada, and Utah, more than half of Colorado and New Mexico, and one-fifth of Idaho and Wyoming. It is even possible that far-flung sections of Mexico will obtain current from the same source. It is suggestive that the territory to be eventually served by the Colorado River stations, within a radius of 500 miles, has today a population of 6,500,000. A similar zone, centering on Cincinnati, has a population of 65,000,000 people.

The dam in Glen Canyon will be situated 75 miles above Grand Canyon National Park, and, in passing, it should be remarked that no thought has been given to invading that reservation for power purposes, although it is recognized that the Park unquestionably holds great potential power resources. The ultimate development of the Colorado River includes the erection of power plants at Lees Ferry, Marble Canyon, Diamond Creek, Grand Wash, and Boulder Canyon, and the combined outlay would be approximately $1,250,000,000—*i.e.*, more than three times the money spent in the digging of the Panama Canal. Today, out of a total possible 4,000,000 hydroelectric horsepower within her boundaries, California has in service only 1,000,000 horsepower; and the remaining 3,000,000 horsepower must be made available promptly in order to take care of the normal annual demand growth in the course of the next fifteen years.

Marble Canyon, on the Colorado about twelve miles above the Glen Canyon dam-site. This gorge will form part of a storage basin 200 miles long

If the railroads within the State are electrified, the yet unexploited 3,000,000 horsepower would be absorbed inside of a decade. The records show that the population of California has grown in the last ten years by about 45 per cent, but the electrical output, on the other hand, has been amplified more than 300 per cent. This is an index of the continually widening use of electricity and the unfailing call for more and more current.

Laguna dam and canal headworks on the Colorado

The citizens of the Eastern States are familiar with California's fruits, which do so much to gratify the palate, and they are similarly acquainted with certain classes of green vegetables which reach their tables long before the home-grown produce is available. But California plays still another prime part in the agricultural side of our economic life: from her rich soil and flourishing fields the nation at large obtains a big percentage of the seeds needed by the truck and home gardener. But for irrigation, these would not be at our disposal, and we should be just so much the more dependent upon foreign sources of supply.

Whatever sectional bias the more intensely manufacturing districts of the East and the Middle West may feel towards the Pacific coast, it is inevitable that the whole nation recognize that those shores are lapped by an ocean within whose bordering lands dwell three-fourths of the population of the world. These peoples offer markets for tremendous quantities of manufactured commodities, and our States of the Far West are so located that they are nearest to these prospective customers. Clearly, the hydroelectric developments of the Pacific Coast States point the way to the creation of another dominating division of America's industrial empire.

Comfortable Houses Made of Straw

A CLEVER method of meeting the housing shortage has recently been devised by a French inventor named Feuillette. His building material consists of blocks of compressed straw which are molded into shape in a press similar to a fodder-press. These blocks are used as fillers for a wooden framework; they are 40 cm. wide and of any length desired to suit the distance between the timbers of the framework. The first row of blocks has sheets of tar paper between it and the foundation to prevent dampness. The outside is covered with a layer of watertight reinforced cement of the same sort used in facing brick or stone walls; the inner walls are also covered with a light coating to which paper or paint can be applied. The windows are placed upon a special support of molded cement.

An important feature of the construction, according to *Le Génie Civil*, is a system of tubes inside the walls running around the perimeter of the foundation and around the first layer of the straw building block. Through these any suitable gaseous disinfectant can be passed so as to keep the house free from vermin. Since both the framework and the building blocks can be constructed in series and shipped to any point needed, these houses can be very rapidly erected, not more than a month or two being required to finish a residence and have it ready for habitation. Furthermore, the inventor claims that 40 per cent of the cost can be saved by construction of this character as compared with houses built in the ordinary manner.

One of the greatest virtues of these houses is the equable temperature maintained in them because of the poor conducting powers of the compressed straw. A number of them have already been erected in the Aisne and other parts of France. They are regarded as being specially adapted to agricultural regions where ordinary building materials are scarce. The elasticity of their materials, too, fits them to resist earthquake shocks. It is stated that the insurance companies insure them at ordinary rates in spite of the inflammable nature of their materials.

The Earliest Inhabitant

Some of the Simplest of the Animal Forms that Go Back Into Geological Time

By William Butterfield

NOTHING is more uncertain than the duration of geological time: estimates of the earth's age, or of the length of certain periods therein, are tripled or divided by three overnight, as new data or a new method of attack upon the problem is developed. But whatever the number of millions of years which we attribute to the frame on which we live, for fully half this time, if not much more, it has been inhabited by the rhizopod family—the original member of which, indeed, was its first distinctively animal inhabitant. And so far as we are able to learn, this individual differed in form and action very little from his descendants still existing, and known under various more or less pronounceable names. It is true that the founder of the dynasty has left no record or other evidence which will enable us to form a definite notion of his personality, character, or physical appearance; yet we may arrive at a fairly accurate understanding of this individual by a study of his lineal descendants.

It is not at all difficult to meet a member of one certain branch: we find hundreds of him inhabiting every square inch of decaying vegetable infusion, not quite putrid, lying upon oozy mud that has for some time lain covered by fresh or salt water. This branch has a rather pretty name, ameba, and is said to be much more highly organized than the first inhabitant. There is little to show that one group of the rhizopod family is more advanced than another, however; all are extremely simple in everything that makes up their bodies.

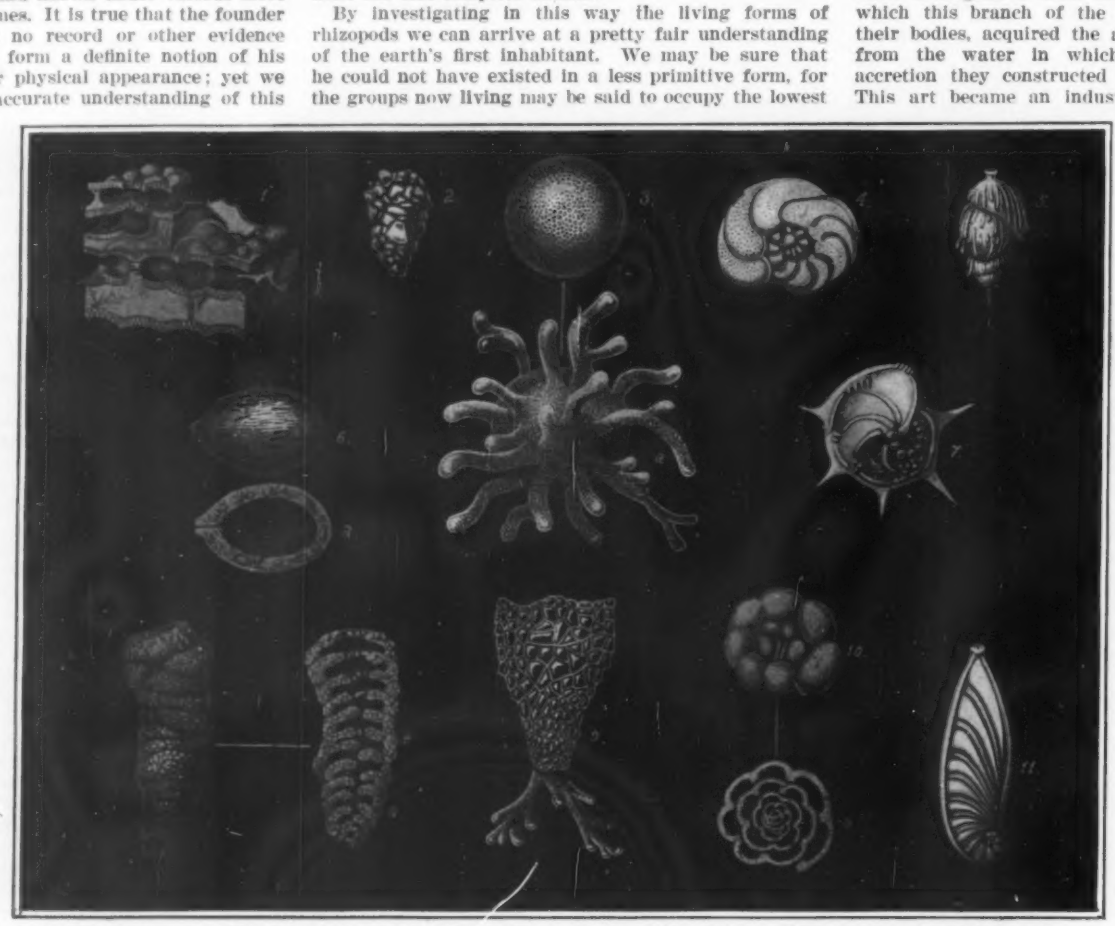
It would be difficult to say exactly what *is* the form of an ameba's body. It frequently has the appearance of a small, rounded mass, like a drop of water; but whatever the form may be, it is always unstable, changing every minute. It is among the simplest organisms in all creation—a mere particle of living matter. Its body is like a drop of thin, almost transparent, mucilage, without head, trunk, limbs, envelope, mouth, stomach, or any appreciable organization whatever. The amount of matter which forms it is so small (a mere twentieth of an inch in length) that often its transparency is such as to enable the eye to see it only by means of a careful arrangement of the light.

Yet this semi-transparent drop of mucilage-like substance—which we show in the drawing at 3 and 3a—is endowed with life and a power of motion. It projects from its body root-like processes—which we show in the second drawing—at times simple, sometimes branched. These are the feet, upon which the animal moves, or the hands, with which at times it obtains its food. Their appearance is different in the several genera. Any projection, having appeared and remained for a short time, will be seen to reenter the common mass, with which it becomes completely reincorporated. When extended, if they come in contact they coalesce, running together like streams of water and often forming thin, lace-like structures.

The body mass is sticky, like the mucilage to which we have already compared it, and filled with minute granules which are seen to be in constant motion, forming currents circulating within the body and its projections. Smaller animals and vegetable organisms, coming in contact with any part of ameba, are attached to it and held by this viscid substance. The food particle thus sinks into the mass, if this be sufficiently large, and is literally engulfed by it: if, however, it be caught by too small a projection to effect this result, the animal flows more of its substance into the region in question and finally succeeds in absorbing the other particle. After digestion is completed ameba disposes of the effete matter by simply flowing away from it.

Reproduction of species is a process quite as simple as that of maintaining life. All that is necessary is for the individual to separate into two or even more portions, each representing a somewhat smaller but none the less complete animal.

By investigating in this way the living forms of rhizopods we can arrive at a pretty fair understanding of the earth's first inhabitant. We may be sure that he could not have existed in a less primitive form, for the groups now living may be said to occupy the lowest possible place in the scale of creation; and he could hardly have been more highly organized, for his contemporary offspring have left us examples of their architectural productions which show this to have been out of the question.



1. Eozoon Canadense. 2. Reophax Difflugiformis. 3. Amœba Proteus—above, resting; below, active stage. 4. Anomalina Oriminensis. 5, Uvigerina Pygmæa. 6. Technitella Melo, with section of a single cavity. 7. Cristellaria Echinata. 8. Bigenerina Robusta, and a section with cavities. 9. Difflugia Pyriformis. 10. Trohammina Coronata. 11. Cristellaria Tricarinella

Some typical specimens of the rhizopods and foraminifera

To speak of architectural productions in connection with animals so simple in organization as we have found the rhizopods to be seems startling to say the least; but it is a fact nevertheless that the original users of architectural structure are to be found among this family. Further than this, they were the first makers of artificial stone, which they used in constructing the prototypes of our modern apartment buildings. They were the original cliff-dwellers; and if we glance at their flats (Fig. 1) we shall be surprised to see that they were by no means uncomfortably situated. Each little dome-topped chamber, placed in rows, and connected by oval passageways, is quite as cozy as anything that a human flat-dweller could possibly have. Many of these "flats" were 50 stories high, each story connected to its neighbors by passages.

Flat-building was rather extensively practiced in the early days, and we find that the rhizopods must have constructed them in such numbers as to have covered practically the whole surface of the earth. That was many million years ago, and a lot of changes have rolled over the earth since then; so we are now able to find only a matter of several hundred thousand square miles of their flat cities undestroyed—the Laurentian formations up in Canada, the oldest fossil formations known. We find that each individual animal builder was only the size of a pin-point, and that his apartment fitted his body in size. Each apartment was built upon the same plan, but they did not have the same number of rooms, showing that small and large accommodations were in demand then, just as they are now in man-made flats.

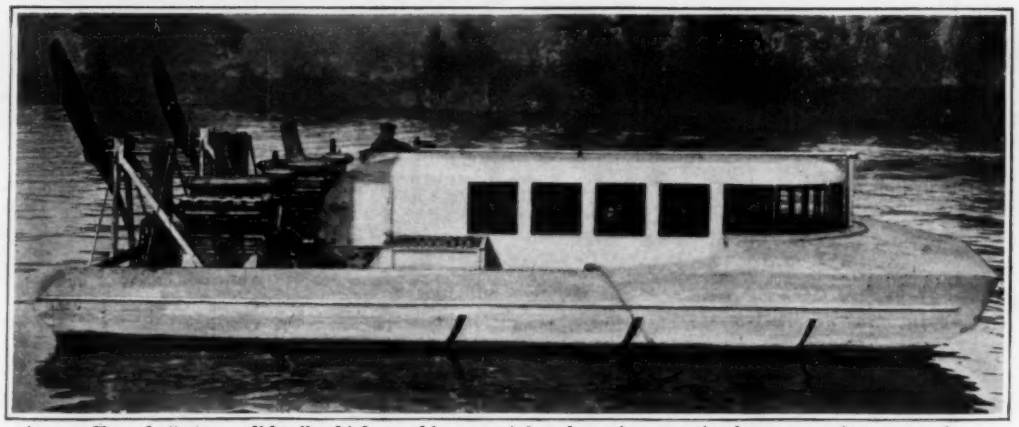
The flat-building cousins of the first inhabitant must have undergone a kind of industrial development in which this branch of the family, without change in their bodies, acquired the art of secreting liquid lime from the water in which they lived. From this accretion they constructed their artificial stone flats. This art became an industrial family possession, to which each member devoted a part of his time—each making his apartment in common vocation, just as the old guilds made cloth, leather, shoes or socks. This trait of animal behavior is called instinct. We see it displayed again in the building of different and distinctive cocoons by the members of various tribes of moths and butterflies, in the tubes of caddis worms, and in the nests of birds.

The rhizopods were, we see, the originators of industrial brotherhoods. If we look at any of the products of some living groups (Figs. 2, 6, 8, 9, 10) we shall find that these families were the first great users of the art of masonry, and the inventors of mortar and stone cements. Some examples of rubble construction (Figs. 2, 9) are remarkably like such work as seen in stone fences, porch-posts and other up-to-the minute products of the human animal. When it comes to the manufacture of fine colored terra cotta (Fig. 10) with an uncrackable glaze, we will find that the workers of these various groups have for hundreds of thousands of years been each surpassing each other in the mechanical precision and beauty of their work. Other groups (Figs. 4, 5, 7, 11), not satisfied to take clay, sponge spicules, pebbles and the finished products of their cousins as building materials, construct glass and porcelain compounds, which they fashion into solid, highly-finished domiciles. (See "Nature's Geometric Workmen," by the present author, SCIENTIFIC AMERICAN, December 27th, 1919.)

What are the tools—the hands, the eyes, the brain—that enable a difflugia (Fig. 9) first to gather the transparent quartz pebbles with which to construct its home; second, to arrange the pebbles in their orderly fashion; third, to hold them in place while the cement that binds them is hardening? It has been seriously suggested that man is superior to other animals only because of the shape of his hands. Here we have an extensive family of several thousand varieties, each species having a tribal instinct to build a definite-shaped home, without the aid of hands, or, apparently, of any organs whatever. Each artisan uses the same material, the same ornamentation or color, the same plan and dimensions. Can anything be more confusing, not to say contradictory, of the common conception that it is brain in an animal that enables it to do these things?

The Latest in Speed Boats

SOMETHING a little bit different, in the speed-boat line, from the conventional gliders and scooters is the French creation illustrated at the top of this page. The craft is of such very light draft as almost to justify the statement that it "sits on top of the water." In this respect it is, of course, little different from most other speed boats; but the manner of its propulsion is more that of the true hydroplane. It is, in fact, provided with two airplane engines which drive air propellers rather than water propellers, just as in a regular plane. The little speeder will make 45 knots when loaded to its designed capacity of five tons; when light it has been coaxed up to 60 knots. At such speeds we may probably assume that it really does rise out of the slight submergence which it normally posses, and rides the surface much after the fashion of a true plane.

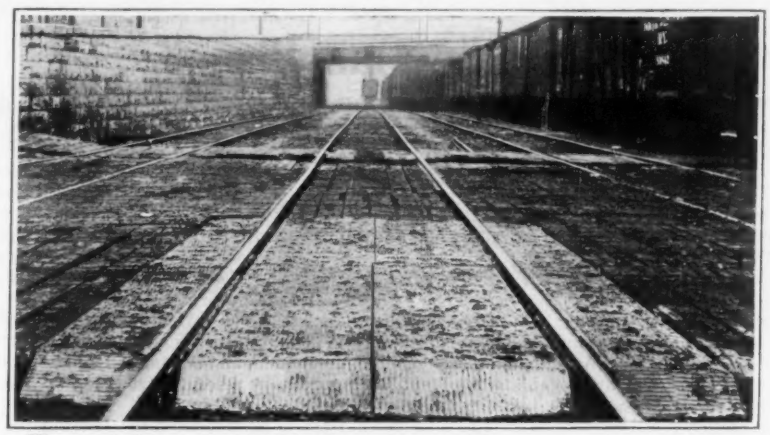


A new French "water glider," which combines aerial and marine practice in a somewhat unusual way

The All-Steel Grade Crossing

TO replace wood or concrete road-crossings over railway tracks a crossing formed of steel plates has been perfected by an Iowa manufacturer. The crossing is made of wrought steel plates supported on the tie by angle plates of sheet steel. They fit between the rails snugly, flush with the top and have a flanged groove for the flange of the car wheels, the edge of the plates fitting tight under the ball of the rails. Lag screws driven into the ties hold the crossing securely down, enabling it to be removed or set back in about 10 minutes.

It is claimed that this type of crossing is self-cleaning and that mud, gravel, snow, sleet or ice will not accumulate on the ties. The ties are kept continually dry because of a current of air circulating all the time between the crossing plates and ties and the further protection of the crossing plates. This thorough ventilation gives a freedom from freezing and thawing, which ruin many crossings.



The steel-plate railroad-highway crossing which is designed to eliminate the usual maintenance difficulties

An Electrical Theory of Memory

IN the *Journal of Comparative Psychology* for June, 1921, Dr. G. W. Crile presents what may be called an electrical theory of memory. If we assume that the organism is an electrochemical mechanism by means of which potential energy is transformed into kinetic energy in the form of heat, muscular action, and electricity, through the coordination of certain organs, then, Dr. Crile asks, how do stimuli which vary so greatly in their nature and in their intensity reach the brain through the vast numbers of delicate receptors of varying kinds, find their way through the intricate paths of the brain mechanism, and produce each its specific response? That is, how is it that light waves always activate the rods and cones of the retina; the coarser waves of sound, the organs of Corti; the infinitely attenuated particles in the air, the receptors in the nose? How is it that the activation of these receptor mechanisms, so delicately attuned to such infinitely small waves of motion and of chemical action, can cause responses as powerful as those produced by the gross injury of tissue?

In answer to his question, Dr. Crile finds that the brain mechanism is operated by electricity. As Mathews suggests, he supposes that all cells are electric batteries. Hence, the large cells in the fundus of the eye, connected with the rods and cones, may be regarded as batteries, attuned to be discharged by the electric energy created by the action of the ray of light on the rods and cones. Nernst first proposed, and many physical chemists have accepted the theory, that stimulation is not due to a continuous flow of electricity, but that interposing membranes must first be polarized by the accumulations of ions, stimulation taking place when a sufficient accumulation has occurred. If this theory be true, then a quantitative element is admitted so that one may suppose that the semipermeable membranes, in the case of the feeble electric current set up by a light wave, offer a correspondingly feeble resistance to be overcome before stimulation is achieved. Once the first cell in the path of the electric current is stimulated, and its electric charge is added, then the charges of the other cells lying along the base of the retina will be "fired" with great rapidity, augmenting the current.

In this connection, it is at least interesting to note, Dr. Crile says, that the cells which are connected with the rods and cones are both large and numerous, whereas the nerve endings which act as receptors for physical injury, such as the sensory nerve endings in the skin, have almost no accumulators in the form of nerve cells to reinforce and augment their stimulus. The inference is that the infinitesimal receptor of the eye, which receives a beam of light of infinitesimal power, has made up for the want of initial physical force by adding a group of accelerating batteries. Were there a set of accumulators in the skin as powerful as those in the eye, endless explosions of energy would result. It is as important that the nerve receptors in the skin should have scant accelerating batteries to minimize the strength of the force in their specific stimuli as it is that the eye should have powerful accelerators to augment the infinitesimal physical force of its specific stimulus. It is of interest in this connection to note that Nissl found that the cells at the base of the retina became exhausted when the eye was long exposed to sunlight. Precisely similar changes are found in the brain-cells generally as the result of a crushing traumatic injury. The blindness produced by sunlight is comparable to the loss of the power to produce body-heat, muscular work or mental action, which results from body-wide trauma. Body-wide prostration is traumatic shock; sun blindness is sunlight shock.

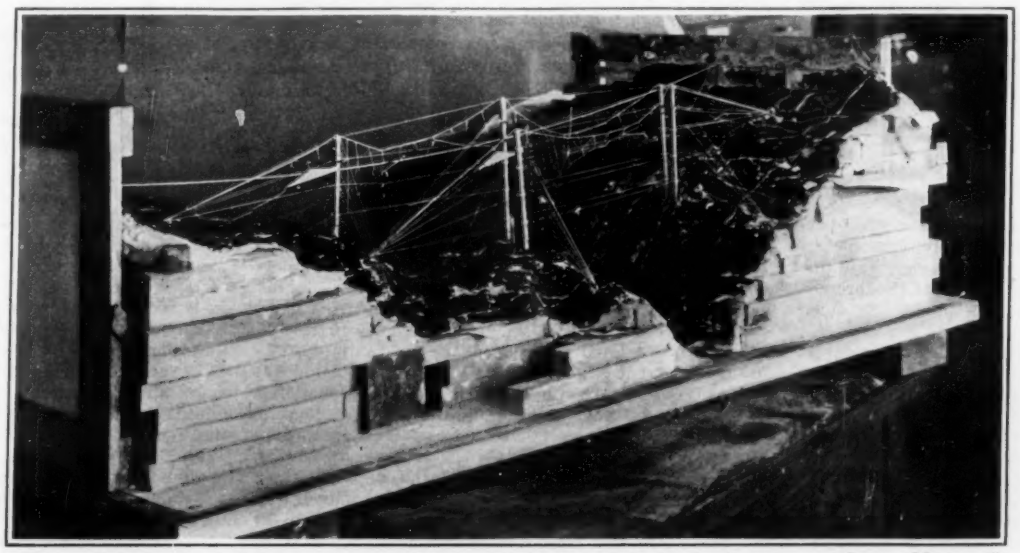
As the passage of electricity through the eye causes the sensation of light, so the passage of electricity through the ear causes the sensation of sound.

Dr. Crile then develops the theory that the white matter functions as a phonograph matrix upon which each incoming stimulus has made its electrical record. When the brain-cells are again roused to action by a repetition of any one of the stimuli which has traced its original record, the outgoing electric impulses released by the stimulus traverse the facilitated path and reproduce the original action. Just as a phonograph record will give back the same words or tune in after years, so Dr. Crile conceives varieties of magnetic phenomena to be written on the white matter, the recording tissue, which is the matrix upon which the action patterns are written.

Long-Range Engineering with the Aid of a Model

IN planning the mixing and chuting plant for the construction of the Barrage de Barberine, a hydroelectric development in Switzerland, it was found that many of the engineering difficulties would be solved through building an exact model of the site and then erecting the plant to scale. A contour map had fortunately been furnished the American firm, and with this as a guide the contour of the ground was reproduced in clay. Then the towers, guy lines, cables and chutes were all built to scale and placed in the exact positions that they were destined to occupy.

When this model was finished it helped wonderfully in solving the problems that had puzzled the draftsmen. The clearance required by a cableway, the location of the guy lines, the use of single or double guy lines, the bracing of the towers—these and many other points were made clear through the use of the accurate model. There was also the satisfaction of knowing that when the plant was finally installed the layout would be correct and the plant would function properly.—*By Geo. F. Paul.*



This model, constructed from a topographic map, reduced to their simplest terms the problems of designing, in America, the plant and equipment for a Swiss water-power project

Left: Transferring the mail from truck to plane. *Center:* No time is wasted on landing; before the engine has stopped turning over, a man is on the wing opening the compartment in which the mail is carried. *Right:* Safety first in starting; one man spins the propeller and two others help and then snap him away from the suction which it sets up

Typical scenes at the air-mail landing fields here in America, proving that we are going ahead in peace-time aviation

Why the Mail Plane?

The Things That Make This Daily Flying on Schedule Worth All It Costs, and More

By C. H. Claudy

WHEN the air mail routes were first established, there was a great deal of hurrah made over them. Little by little they have faded out of the public mind—and some of them out of existence altogether. Nevertheless, in spite of the utter absence of furore about it, the mail pilots are flying every day over the route from New York to San Francisco, flying on schedule and in every weather save actual storm—flying in weather in which it would two years ago have been considered suicidal to attempt a flight. In this story Mr. Claudy tells us what it is all about and, as his sub-title indicates, why the experience being gained by these hardy pilots is worth far more than it could possibly cost. To his question whether air mail should be extended there can be, we think, but one answer.—THE EDITOR.

WITH a million and a quarter annual appropriation for the air mail service, it is not possible at present prices for labor, material and supplies, to do more than maintain the transcontinental mail service authorized by law. If we are to have more air mail service, we must spend more money. Whether that "more money" is justified or not is not a matter of opinion, but a matter of facts.

Here are some of the facts:

Aviation now, like railroads half a century ago, is finishing its first experimental period, and entering upon its era of extended commercial use. The railroad system of the United States leads all the world in trackage, in speed, in comfort, and, in its larger units and as a whole, in efficiency in ton miles per unit of cost. That these things are so is a direct result of that government subsidy and encouragement given the railroads in their early days, through land grants and other privileges.

Aviation is too expensive to be developed by private capital, unless that development is extended over a very long period of years. Without government help, aviation will develop, but it will be done by a private company here, a courageous group there, a daring flyer "on his own," the advertising genius of some spectacular newspaper-contest manager. Such agencies must necessarily take time. During that time other countries are developing aviation rapidly through government aid.

It is unquestionable that mail transportation *via* plane is expensive, compared to the same transportation *via* rail. No postal authority has ever yet been able to decide what proportion of two cents an ounce per letter went to pay for carriage, and what percentage paid for overhead; it is unlikely that such a decision will ever be final, since carriage charges differ so for almost every letter. But whatever the proportion, it is vastly less in rail than in plane. So much is freely admitted at the start.

But the end and aim of the mail service via plane is not only carriage of letters. Let that fact be firmly put in mind and kept in view: the speedy carriage of first-class mail is the *postal reason* of using a plane for mail transportation, but the government aim is at a higher target. That target is, briefly, the creation and keeping fit of a competent body of flying men; the creation and keeping fit of a fleet of up-to-date planes; the creation and keeping fit of a practical and useful equipment of flying fields, wireless, corps of mechanics, and airplane repair and constructive shops; and the continual collection of data regarding flying in all weathers, in all directions, in all winds and temperatures in all our latitudes.

Mail flyers fly according to schedule. There is the crux of the matter as far as airplane information-gathering is obtained. With the exceptions of obviously dangerous or "impossible" atmospheric conditions, the mail flyers leave their terminals at fixed hours, on time, to arrive at their destination at or about fixed hours. One or two flights under such circumstances may tell little; when the miles so flown come to be measured in millions, averages of conditions and extremes of possible conditions are obtained which become the basis and which are the only possible basis for an exact knowledge of the atmosphere as it affects flight, and continuous flight under all conditions as it affects engines and planes and all the delicate parts thereof.

There is no guesswork in the operation of mail service via plane. Exact statistics are kept of every performance, and thus of average performances. Let us look at a few of these. For the 31 months from May, 1916, to November, 1920, mail planes flew 1,211,765 miles. They carried 1,244,194 pounds of mail (49,767,760 pieces) at a cost of $1,246,055.60, which includes 6 per cent on the investment and all cost of rebuilding crashed planes and repairs, but not depreciation of planes, as most of this is charged to discarded surplus war material.

The average performance, by months, was 83.93 per cent perfect. For twelve months the performance was from 95 to 100 per cent, for two months from 69 to 70 per cent; and the balance of the time is reported in 4-month periods, which were, respectively, from 75 to 80, 80 to 85, 85 to 90 and 90 to 95 per cent perfect.

During this period there were 812 forced landings, 446 due to motor trouble and 366 due to weather. Both causes are as yet to some extent unavoidable, but both results are being made smaller. Liberty engines, used almost exclusively, give less and less trouble as the period between overhauls is adjusted to the individual flight conditions, and weather-forced landings grow less as men learn the better to judge conditions. It is of interest to note that the averages work out to prove that a flyer can count on 2717 miles of mail flying to every engine-trouble-forced landing, and 3311 miles of mail flying for every weather-forced landing.

The cost of mail flying is: overhead (which includes departmental salaries, freight and travel, printing and incidentals, radio, telegraph and telephone, 6 per cent interest on investment and 16 2/3 per cent depreciation on equipment other than planes), 12.59 cents per mile; field operations, including gas, grease and oil, office force, motor cycles and trucks, rent, heat, light, telephone and water, pilots, mechanics and helpers, repairs and accessories and miscellaneous, 88.92 cents per mile; losses (crashes and fires), 34.6 cents per mile of flight. These are 31-month averages. Many recent months reduce this, for instance, September of this year shows an average of but 70 cents for total cost, including testing and experimental work.

At the present time but one line of mail service is in operation: New York to San Francisco. It goes via Cleveland, Chicago, Omaha, Cheyenne, Salt Lake City and Reno. It requires two and a fraction days in summer and three and a fraction days in winter to make the trip, taking longer coming east than going west. The time saved in the mail transportation is perhaps best illustrated by a single leg of the journey. In a record flight made by mail planes between Salt Lake City and San Francisco on Friday, October 14th, the time consumed from take-off at Salt Lake City (5.32) to arrival at San Francisco (11.33) was six hours and one minute. Service stops were made of 11 minutes at Elko and of 20 minutes at Reno; therefore the actual flying time was 5 hours and 30 minutes. Train No. 9, the fast exclusive mail and express train operated over the Southern Pacific Railroad, has a schedule of 24 hours and 15 minutes between Salt Lake City and San Francisco.

"Air mail statistics are not compiled to make a showing, but to furnish dependable data to persons desiring

to enter the field of commercial aviation," says the Post Office. The data must be safe to make them of value; for this reason the statistics are reviewed at the end of each year and checked against the audited and outstanding bills for the service. For this reason, likewise, the air mail service has inclined toward a liberal rather than a close valuation of its investment.

The per-mile units of cost in the air mail statistics are all based on the substantial scale of one million or more miles of operation. On such a scale they may be depended upon as reliable averages for the type of planes and the character of operation which they represent; that is, flying daily under rough field conditions, with all manner of forced landings and in all kinds of weather.

The total investment of the air mail service is $743,450; $133,450 for buildings, trucks and tools, and $610,000 for airplanes. The buildings, tools and planes purchased are charged at the prices actually paid for them. The tools and trucks transferred to the air mail service without cost, out of the surplus war stock of the Army, are charged at the price at which they could have been purchased in the market. The airplanes which were transferred by the Army to the air mail service out of the surplus war stock are charged at their original cost to the Army. Had they been charged at the market price for such surplus war stocks the value of the equipment would be possibly one-half of the value at which they are carried on the books of the air mail service.

It is not a particularly safe game, this airplane mail carrying. The great enemy is fog at landing, and only a reliable and definite signal which can penetrate fog, or a plane which can settle to a landing rather than slide down to it at speed, can eliminate this danger. So far we have a record of one fatal accident to a pilot for every 124,048 miles flown and one fatality to a mechanic for every 322,525 miles. The percentage of mail damage is one-tenth of one per cent.

Every possible precaution is taken to conserve life. Pilots are not required to fly when conditions are bad. They go up, with the mail; if, when they are up, they find conditions such as to make the flight dangerous, they return. The best of planes, frequent engine overhauls, good fields, the best of maps and flying directions, a network of wires and wireless for weather information, a daily report of each flight made, not only make this *on-schedule-flying* as safe as may be, but make this mail service the greatest collector of data on safety in flight which this country possesses.

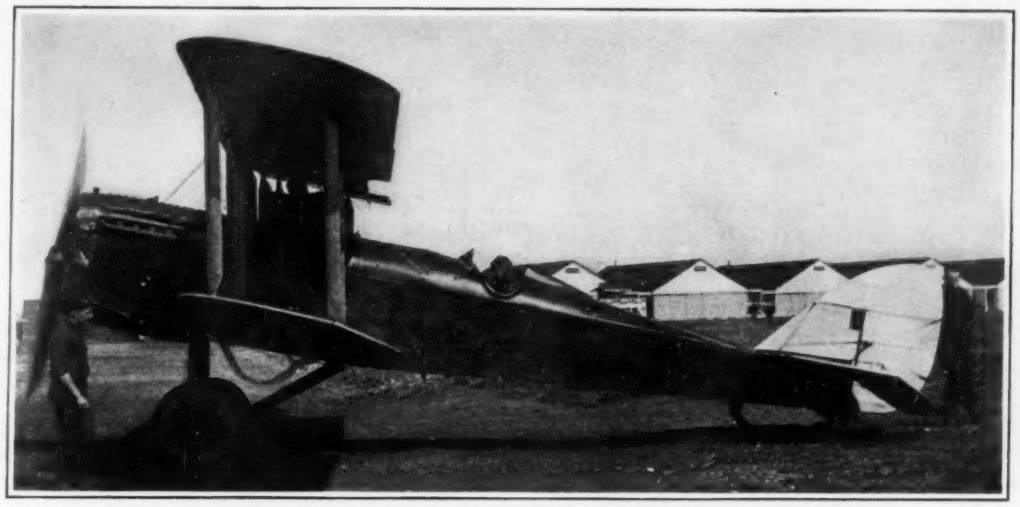
The facts here presented could easily be used as an argument against the need of extending the air mail service, for the benefit of the taxpayer. They can as easily be used as arguments for extension, since we all know that speed of mail transportation makes far better business and more of it. No argument is needed to show that if we can afford it air mail service will cut the time of mail transportation down by a large percentage.

But whether, from the postal standpoint, we can afford it or not, it seems obvious *we can not afford to do without it, greatly enlarged, from the standpoint of national defense and a national expansion of business, via aviation.* In the writer's view this leaves nothing to be said against aerial mail extension.

Let us hope we never have another war. If we ever do, it will be largely in the air. The more we are "in the air" in advance, the less likely, then, we are to have another war. If we must fight, a nucleus of flying fields, trained personnel, available planes and practical flight data will be invaluable.

At present our aviation interests are commercial. How to make the plane a freight carrier, how to put wings to business as we put them to war and letters, is the greatest scientific business problem before us. And at the present time we are governmentally aiding in the solution of it only with a single east-to-west line. We need north-and-south lines. We need diagonal lines. We need a network of air mail lines—not merely one transcontinental line. They can't begin to cost us what they are worth to us.

Hence, for you who read, and those who sit in Congress and appropriate, the question to be answered is not only "is this form of mail transportation worth what it costs in terms of mail?" (and, by the way, the postage on the mail so carried much exceeds the cost of carriage); but, in terms of aviation, in terms of knowledge gained, in terms of encouragement to and development of commercial aviation, isn't it worth so much more than it costs in money that the United States *can not afford to do without* the rapid and great expansion of its air mail service?



Air-mail plane being tuned up and warmed up preparatory to the take-off

Form

Division EASTERN

DAILY FLIGHT PERFORMANCE

Second Assistant Postmaster General

AIR MAIL SERVICE

MAIL FLIGHTS

Headquarters New York *Date* October 18, *1921*

	WEATHER	SHIP NUMBER	AVIATOR	FROM—	TO—	LEFT	ARRIVED	TIME Hours	TIME Mins.	MAIL RECEIVED No. of Pouches	MAIL RECEIVED Pounds	MAIL DISPATCHED No. of Pouches	MAIL DISPATCHED Pounds	MAIL ARRIVED AT FIELD	REMARKS	
WEST	Hazelhurst ceiling 1000 ft. visibility 1½ miles	283	Muking	N.Y.	Bellefonte	706	1035	3	29	10	359	1	4			(a)
		193	Leonhardt	Bellefonte	Cleveland	1045	100	2	15	1	4	10	359			(b)
	CLEVELAND party cloudy	192	Smith	Cleveland	Colton	724	925	2	01	11	193					(c)
				Colton	Bryan	145	233		48							(d)
				Bryan	Chicago	252	510	2	18			11	193			(e)
																(f)
EAST	MAYWOOD Ceiling 2000 ft. visibility unlimited	94	Jones	Chicago	Bryan	1102	1220	1	18	10	403					(g)
				Bryan	Cleveland	1222	127	1	05			10	403			(h)
	BELLEFONTE ceiling unlimited ground fog	187	Bishop	Cleveland	Bellefonte	704	915	2	11	10	400					(i)
		189	Lewis	Bellefonte	N.Y.	922	1151	2	09	1	4	11	404			(j)
																(k)
																(l)
					TOTALS					45	1363	43	1363			

A sample of the reports by means of which strict account is kept of all the essential data connected with flying on schedule

Rats Invade Oceanic Island

UNTIL three years ago Lord Howe Island, 300 miles east of the Australian coast, was entirely free from rats. Then some rats came ashore in the cargo of a stranded vessel and they have completely upset the balance of nature. They swarm all over the island and bid fair to exterminate most of the land birds, including the woodhens *(Ocydromus sylvestris)* which are confined to the island and find their nearest allies in the wekas and kiwi of New Zealand, which they resemble in being flightless. This they do by devouring the eggs. The rats also eat the seeds of the thatch palm (*Howea fosteriana*), a species peculiar to the island. These seeds, from which are grown most of the table palms of the world, are the chief and almost the only export of the island. So far no means have been devised of dealing with the rat plague.

Populations and War

IN the first volume of *Metron*, a new Italian periodical devoted to the science of statistics, Mr. G. H. Knibbs discusses the theory of large population aggregates. Any large population group, Mr. Knibbs says, must necessarily tend at each moment to increase according to an exponential law with a positive index, and the rate of which initially may accelerate. In all cases this rate must ultimately decrease, until it becomes zero.

In order to realize what must be the general history of large population aggregates we need to develop a method by which we can anticipate what may be the normal development. Accessions of knowledge, however, and widespread changes in regard to standards of living can operate to produce sharp changes in population facts. After these have transpired they may be regarded as furnishing, as it were, a new datum value from which the future may be considered. The result of the increase will always be that the limiting density corresponding to the totality of existing conditions is more quickly approached, and, as it is approached, it becomes more and more difficult for the same rate of increase to be maintained. Ultimately it can not be maintained, and as soon as this is the case collision with neighboring population groups is inevitable. These are unavoidable so long as any group regards itself as entitled to expand irrespective of the rights of adjoining groups. Such collision is, of course, war, and war is inevitable unless concerted action is possible, the object of which is to come to a common agreement as to rate of increase. This can be reached only with a high state of discipline and knowledge. The present population of the world, and its recent rate of increase, is such that it can not be maintained even for a few centuries, since it may easily be shown that no possible accession of food supplies could meet the requirement.

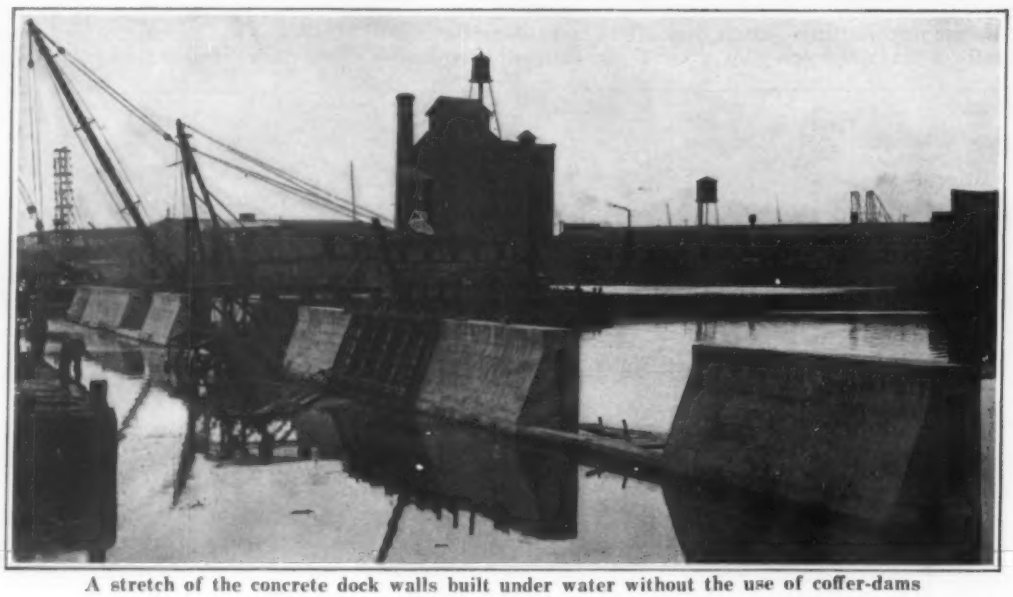
Even a very moderate rate of growth can not indefinitely postpone trouble, and a people can save itself in this respect, only in so far as they can increase their efficiency to the highest possible limit, and also restrict themselves in regard to all unnecessary luxury. Whatever advances are made in science, and its applications in industry, and in food supply, they can not of themselves postpone the ultimate resistance to further development, which must inevitably increase.

Pouring Concrete Under Water

Barge Canal Dock Walls at Buffalo Built Without the Use of Coffer-dams

A NOVEL and highly successful method of building concrete dock walls is being used in the construction of the Ohio Basin at Buffalo for the New York State Barge Canal. The novelty consists in the substitution of large and massive steel forms for the coffer-dams which are customarily used in building subaqueous walls.

In building under-water foundations, whether bridge piers, dock walls or the foundations of office buildings which have to be built in water-bearing strata, it is customary to construct coffer-dams or caissons of the approximate size and shape of the foundation; excavate the material from within the structure, either by open dredging or by forming a bottom working chamber and using compressed air, and then building up the masonry or concrete within or upon the structure until it has been carried above water level and to the finished height.



A stretch of the concrete dock walls built under water without the use of coffer-dams

Now this is a tedious and expensive process, and it occurred to Mr. F. C. Hibbard, engineer and superintendent of the work at Buffalo, that since the wall was to be built of concrete it could be done more expeditiously and at less cost, if it were built in sections and if each section were poured within heavy steel frames extending from the bedrock to and above the surface of the water. The very interesting steel structure which is shown in our illustrations was designed for this purpose and has done the work with great satisfaction both to the contractors and the state engineers of the Barge Canal.

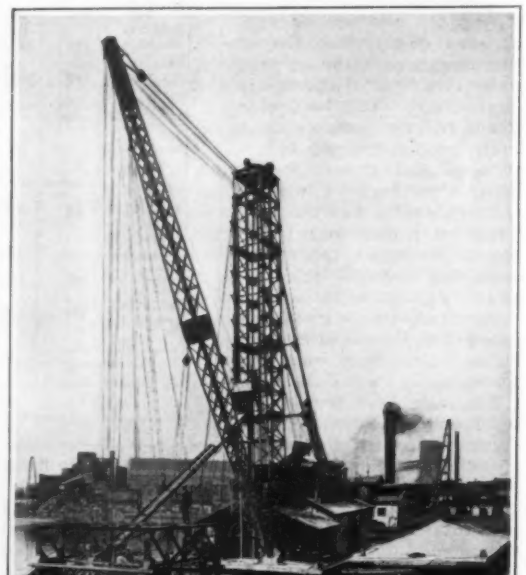
The part of the Ohio Basin with which we are concerned in this article is a concrete wall 1550 feet in length, which rests on the rock at a depth of from 21 to 28 feet below mean water level, the finished wall being from 28 to 35 feet in height.

The concrete form is carried within a deep and very rigid frame of the character shown in our illustrations, which is sufficiently larger than the concrete wall to enclose it and still leave room for the adjustment of the forms. The forms for the front and back of the wall are suspended from the top of this frame, and they are held in the desired position by means of screw jacks and toggle arms. These adjusting appliances are such that the distance between the forms and their inclination can be adjusted with great nicety. Heavy jack screws serve to give the necessary vertical adjustment.

Each end of the forms is closed by means of a bulkhead which is attached to the forms by means of lugs. The lower part of the forms is built of timber. This is done in order to accommodate the forms to the varying depths and irregularities of the contour of the rock below. The first sections of the wall were poured where the water depths was greatest, and, as the depth reduced, the bottom timbers of the forms were removed. When the form is submerged it rests on four posts, one on each corner of the enclosing frame, which are adjustable in a vertical direction. As soon as the form is in place, the surface of the rock is cleaned by means of a centrifugal pump, the mud having been first loosened by the use of water jets operated by divers.

The wall is constructed in 20-foot lengths, and when the concrete has been poured and has been allowed 48 hours to set, the form is loosened from the face of the wall by means of the jack screws and, with its enclosing frame, is lifted clear of the wall and placed in position for the next section. Mr. Hibbard, manager of the Great Lakes Dredge and Dock Company, informs us that he has built 75 feet of complete wall in six days, and that this is something that would have been absolutely impossible had they used the coffer-dam method. That would have involved the various operations of driving, sheathing, bracing the coffer-dam and excavating the material inside, cleaning off the rock, building forms, pouring concrete, waiting for it to set, removing the forms and removing the coffer-dam. These many details of operation are eliminated by the new method. Two hundred and eighty yards of concrete are placed at one pouring, and, of course, the form and its frame had to be built with a special view to resisting the heavy pressures while this mass was in the liquid state. In some of the first blocks a manhole two feet in diameter was placed in the center of the form down to the rock foundation. At the end of 48 hours after the pouring was complete this manhole was pumped out with a view to examining the concrete blocks from the bottom to the top. It was found that concrete placed in the water with a bottom dump bucket was equal to any concrete with which the company had had experience either on dry land or in water.

The massive steel form being lifted from the working barge



Steel form lowered into position ready for pouring the concrete

Capacity Effects in Inductance Coils

A COIL of wire wound in any of the familiar forms called "inductance coils" behaves in an electric circuit primarily as an inductance. The potentials of the different parts of the coil are, however, different from each other and from the potential of the ground. For this reason the coil also behaves to a certain exteht as an electric condenser, or rather a system of condensers. These capacity effects of inductance coils are particularly important at the high frequencies employed in radio communication. The effective capacity of an inductance coil depends in general on the capacities existing between parts of the coil and the ground.

On account of the importance in radio communication of capacity effects in inductance coils, careful studies of these effects, both theoretical and experimental, have been made at the bureau. An interesting result which has been found is that one effect seems to depend primarily on the capacity of the coil to ground. This effect is observed when two condensers in series are connected across the terminals of the inductance coil, and the common terminal of the two condensers is grounded. If the inductance coil possesses capacity to ground, the familiar formula for resonance in the system, computed from the known values of the capacities of the two condensers, will not apply.

If both condensers are variable and the system is adjusted for resonance by successively assigning arbitrary values for the setting of one condenser, and then tuning with the other condenser, it would be expected from elementary considerations, neglecting the effects of distributed capacity, that the successive resonance values of the capacity of the two condensers in series, determined as the product of their capacities divided by their sum, would be constant. On account of the distributed capacities, this simple relation does not hold. It is found, however, that under the conditions above mentioned, with the common terminal grounded, the capacity of the two condensers in series determined as the product of their capacities divided by their sum, is linearly related to the reciprocal of the sum of their capacities. This relation has been verified both mathematically and experimentally.

The results of both the mathematical and experimental investigation of this particular phase of the problem of capacity effects in inductance coils are given in a publication of the bureau which has just appeared, Scientific Paper No. 427, "Some Effects of the Distributed Capacity between Inductance Coils and the Ground," by Gregory Breit. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

What and Why Is a Contour?

By S. R. Winters

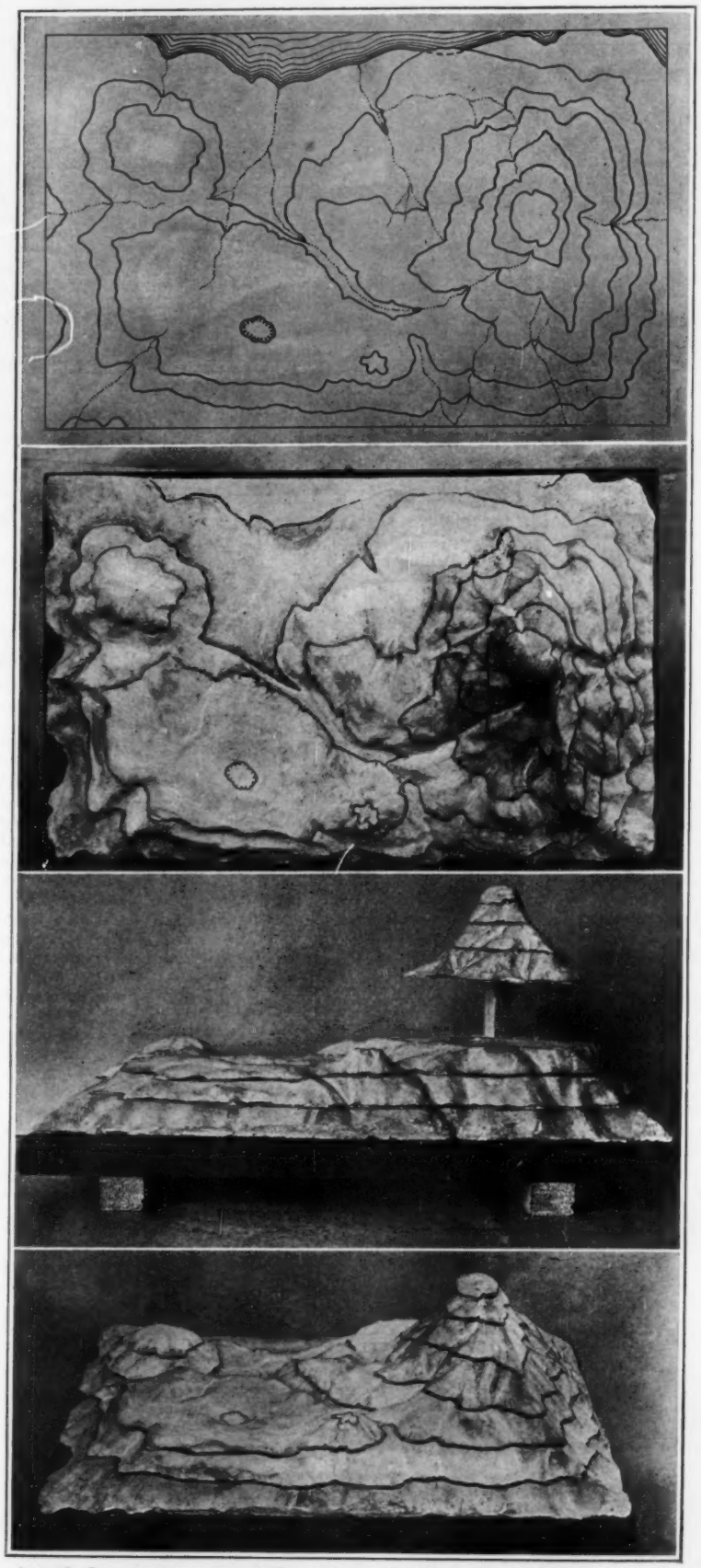
THE question "What is a contour map, and what does it mean?" comprises an inquiry which has prompted M. W. Talbot of Albuquerque, New Mexico, to design for the United States Forest Service the first working model showing the meaning and purposes of a contour map. Instead of a single model, however, this ingenious device is a series of models, unfolding, in progressive fashion, the significance of a contour as it expresses altitude, shape, and grade of an object. These three elements, when visualized, are accepted as a correct definition of topography; or, in the parlance of the street, the "lay of the land."

This graphic way of answering the question "Why is a Contour?" is accomplished by a mass of pliable substance mounted on a thick piece of wooden board. The model, representing a mountain, is one foot long, and the supposition is that one-half inch equals one hundred feet. Sea level, as we compute height in topographic terms, is always zero. So, this working model begins its story by the use of a knife, representing a gigantic carving implement, cutting in a horizontal plane 100 feet above the imaginary seashore line. This is demonstrated in one of the photographs. Having slashed the miniature mountain into layers 100 feet thick, the results are portrayed in the other illustrations of the group.

The thickness of these slices is not arbitrarily fixed at 100 feet; variations therefrom might be dictated by the needs of the particular contour map being used. However, a specified thickness is always uniform for any one map. That is, the vertical distance between one outline and the next—the thickness of the layer—is the contour interval. The knife, in divorcing one slice from another, leaves a crack on the surface of the pliable substance or model which represents a contour line. These demarcations are illustrated in the three photographs of the series of models. This graphic presentation of what a contour consists of may be amplified by text which the designer of the clever device has picturesquely done: A shore line of a lake, a trail in the snow as one wanders in and out among the forests provided he does not climb or descend a hill, the edge of a flat-topped butte, a flume along a canyon wall built by mistake on dead level instead of on a slight grade, and even the hoop of a barrel—these are examples of contours!

Having discovered the meaning of a contour, the logical question is "Of what service is it?" Take another peep at the mountain, which, viewed from an equal elevation, will look just as the third photograph would look if it were all in one piece. Then tilt the model mountain at an angle shown in illustration number four. Again another slant sidewise, with a continuation of the tilting process until the big hill is seen from squarely above, looking straight down as in views one and two. If one's imagination is more vividly stimulated from the air, observations may be made from a balloon, looking downward on the mountain when soaring directly over the monumental hill. Whether your feet are planted on the ground or you are on a sky-climbing errand, the mountain will appear as shown in our first two pictures. For the former of these is a contour, or, as sometimes described, a topographic map.

The Forest Service has devised another method of bringing out the relation between relief and its representation on a flat surface. The lower slice is placed on a map sheet and a pencil line is drawn around the base—thus, you have a contour line. The process is duplicated with other slices, the general character of the resulting slices being well indicated by the third and fourth of our photographs. The performance is repeated with each of the remaining slices, and the result is another contour map. Both methods, as here described, have succeeded in transforming a mountain into its own topographic map. The first way told about involved the use of our eyes by changing the viewpoint from a like elevation to a point directly overhead. The second method may be defined as a mechanical one, by drawing a pencil around the base of each slice. Thus the clew to what has been happening is revealed. In order to draw a line around the base of slice number four, say, as depicted in our views, it was essential to lower this to the map sheet a vertical distance equal to the combined thicknesses of the three layers which fit below it. This lowering performance, if conducted straight downward in the direction of a plumb line, is known as *projection*. This kind of projection does not influence the appearance of a contour when seen from above.



A typical contour map, and three views of the model which interprets it. Of particular educational value is the one in which some of the levels are displaced vertically. The "contour" interval is 100 feet, so the slices of the miniature mountain represent an actual thickness of 100 feet

Our third photograph illustrates the point with reference to projection vividly. Elevate one or more contours and the principle is unchanged. That is, if one is in an airplane directly above the mountain it would be impossible to distinguish whether the contour of the fourth layer is at elevation a, b, or c. In fact, the normal location of the contour shown in this view is at one level, its displaced location at another, and its projected location at still another.

Finally, contours, expressing as they do altitude, shape and grade, permit an instant calculation of the approximate height of any point. Begin at sea level or zero elevation, count the contours up to the particular one wanted and multiply the count by the contour interval. A topographic map, to the user, should mean something more than a jumbled mass of lines or a vague guide to stream direction and mountain location. It has been defined by the Forest Service as a near-photograph of the "lay of the land," enabling one to traverse regions hitherto untraveled by the visitor and still know throughout the trip of your whereabouts.

Christopher M. Spencer

HARTFORD, Conn., papers of January 15th give much space to the death, on the morning of the 14th, of Christopher Miner Spencer. Mr. Spencer is one of the outstanding figures in American invention, and a shining example of the manner in which great industries are built up on patents. Extended biography of him here is rendered superfluous by the fact that his career was rather fully outlined in a special story in our issue of December last. Inventor of rifles, shotguns, automatic lathes, screw machines, forging processes, and a wide variety of other modern machines, and founder of one of the largest firms in America manufacturing shop machinery, he was in every way representative of the Connecticut Yankee of the best type. He was 88 years old, and as recently as October last, when he was a welcome visitor in our editorial office, he was hearty and vigorous in spite of his years.

The Flexible Key as a Prevention of Robberies

A FLEXIBLE key, one that will go into and work in a tortuous hole, has been developed in Germany. The many robberies that are constantly reported everywhere have created a demand for such a key. According to a British writer's description, the wards and the bow are not connected by a stiff stem, but by four superimposed strands of ribbon steel which prevent any sideways movement when the key comes into play. Thus there need not be a straight-way between the escutcheon on the front of the door and the actual keyhole in the lock-case, which can be fixed at an entirely different level, and the point of introduction for the key is independent of the locking point. Between the outside and inside fittings there is a tubular channel with a slit in the bottom to allow the passage of the wards. This channel in German is called "Schlüsselzuführungsschiene," or literally "key-conveying rail," a word long enough to insure the prevention of burglary. The housebreaker is unable to determine the position of the locking mechanism, nor can he open it with a false key, a wire brush, or a strip of lead. To blast it open is out of the question, as the explosive would fall out through the slit in the keyway made for the passage of the ward. The flexible key is not as unwieldy as one might expect, because it can easily be rolled up into a spiral and put into a neat case to fit the pocket of its legitimate proprietor.

The Peer of Decorative Hardwoods

Rosewood: What It Is, Where It Comes From, and What It Is Good For

By C. D. Mell

THE undisputed precedence among fancy furniture woods has been conceded to rosewood since its introduction into the world's markets. Manufacturers of the fine styles of furniture and interior trim consider it the epitome of beauty and elegance and the emblem of refined taste. It has been a favorite wood among makers of musical instruments and fancy cabinet work for about 300 years, as may be attested by the amount of antique rosewood furniture that has been handed down from generation to generation.

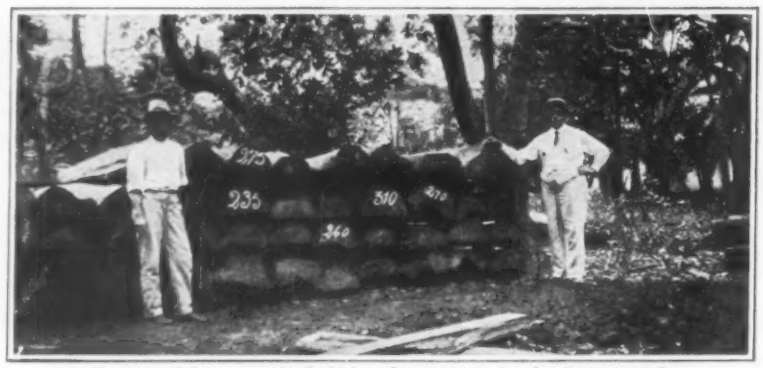
The word rosewood, as used in this article, has reference only to the genuine kind which emanates from Brazil under the local or Portuguese name of jacaranda cabiuna, or simply cabiuna. This word was introduced into the European markets prior to 1660, and it is believed that consignments had reached France and England during the 16th century. There are evidences that rosewood furniture existed in the mansions of the nobility and gentry during the reign of Queen Elizabeth, for at this time the homes of the rich had acquired a splendor of fitting and finishing which they had not before displayed, and of which abundant evidence is even yet to be seen in some of the well-preserved old manor houses in England and among the exquisite decorative features in the castles of continental Europe.

Before the year 1600 full cargoes of dye woods were shipped out of Recife (Pernambuco) to Europe, and at a somewhat later date similar shipments emanated from San Salvador (Bahia), and among these were logs of rosewood which received the name of palisandre (a word corrupted from palo santo, meaning holy wood) in France, and rosenholz in Germany, because the odor of the wood resembles that of roses.

The earliest records refer to this wood as Pernambuco, which is the name of the province where the logs originated; later shipments emanated from the State of Bahia, and for many years it was known in England as Bahia wood, and a still later name was Victoria wood, so called because the logs were shipped from Victoria, a seaport town in the State of Espirito Santo. The two chief trade names which persist to the present time are palisandre and rosewood; the local binomial, jacaranda cabiuna, is rarely used in the trade. The scientific name is Dalbergia nigra.

The present supply of rosewood logs comes chiefly from regions south of Bahia, Victoria being the chief shipping port for this commodity, and approximately a thousand tons of it in the form of rough logs with the bark and sapwood hewn off are shipped into the United States annually. An equal quantity finds its way into the European markets. This quantity represents less than one-third of the stocks that were exported from Brazil during the days when rosewood was used more extensively than it is now.

The use of true rosewood in the United States has been on the decline for over two decades, and one of the chief reasons for this is that substitutes are now being introduced. Another reason for this is that a large percentage of the logs show serious heart defects and that only a small proportion of the logs produce clear lumber, which is so essential in the manufacture of interior trim and cabinet work. As a result of the increasing number of poor quality logs in the shipments received here, consignments have frequently been rejected by consignees, and on account of the eventual sale of the logs at great sacrifice, the shippers at sources of origin refused to forward further stocks except upon the receipt of firm orders with letters of credit established in their local banks. Dealers and commission houses here have always been reluctant to comply with such terms, and the result was that shipments of substitutes from other parts of the tropics were encouraged. Cocobolo and other so-called rosewoods have taken the place of true rosewood and are now in general use here. Upward of 2000 tons of these substitutes are being consumed in the United States annually. The annual consumption of rosewood of all kinds in this country for all purposes is shown in the following table compiled by the United States Forest Service:



Rosewood logs, cut in half by the pit-saw in the foreground

Industry	*Feet board measures*
Professional and scientific instruments	219,353
Fixtures	52,925
Musical instruments	49,645
Railroad cars	37,000
Sporting and athletic goods	24,400
Handles	15,456
Furniture	15,280
Brushes	12,050
Faucets	10,642
Artificial limbs	10,000
Doors and sash	6,100
Carpet sweepers	5,500
Novelties	3,613
Picture frames	2,420
Electrical apparatus	2,200
Boats	1,600
Shade rollers	1,000
Plumbers' woodwork	1,000
Clocks	290
Tobacco	100
Total	471,734

Rosewood logs, showing the common heart defect

Handling rosewood from the yard to the pier at Rio de Janeiro

The total number of feet given here represents approximately 3000 tons of logs in the rough, which confirms the estimates already made that there are about 1000 tons of true rosewood and about 2000 tons of substitutes entered here annually for consumption.

Rosewood is expensive, which militates somewhat against its more extensive use here, less so in Europe. While the price of true rosewood was about $100 per long ton during the war, it can be laid down now in New York for less than half that figure. But even this is an unusual price for wood when it is calculated in terms per 1000 board feet. It requires approximately five tons of logs in the rough to yield 1000 board feet measured by a standard log rule, but this does not take into consideration the great amount of waste due to defects. At $50 per long ton figured on the basis of board feet it is $250, but less than 200 board feet of this represents clear stock.

Quoting the *Hardwood Record* for October 25th, 1918: "The average price paid during a whole year for rosewood by manufacturers in Pennsylvania was $462.89 per 1000 board feet. The wood is nearly always bought in the log, and if it is purchased by weight, the price is figured on the foot basis. The average price during a year in Illinois was $233; in New York, $219.89, and in Connecticut, $225.40."

Petroleum Wastes and Savings

AN investigation of losses of crude oil through evaporation in storage and in transportation, conducted during the year by the Bureau of Mines, disclosed losses of startling magnitude. It was found that in the few days in which crude oil is stored on the lease before being taken by the pipeline the aggregate loss per year from evaporation amounts to about 122,000,000 gallons of gasoline in the Mid-Continent field alone. This has a value, at 22 cents per gallon, of $26,840,000, and represents about 3 per cent of the total gasoline produced in the United States from all fields and all sources. The bureau found that a large per cent of this loss could be prevented by the use of efficient equipment.

The Bureau of Mines has pointed out the considerable losses which have resulted from the failure of many refineries to recover gasoline from uncondensed still vapors. The significance of this investigation is shown by the fact that one refinery in the Mid-Continent field is now recovering from still vapors approximately 400 barrels of gasoline daily that before the installation of this equipment was either lost or burned as fuel under the boilers and stills. The value of fractionating towers at petroleum refineries, by means of which some companies have increased the yield of gasoline from crude oil by as much as 5 per cent or 16 2/3 per cent of the total gasoline yield, has been demonstrated.

Large quantities of gas are now being wasted in the Osage Nation in Oklahoma because of low-pressure conditions, and the Bureau of Mines is investigating the feasibility of utilizing this waste gas by the use of low-pressure burners for oil-field boilers. The demand of the export market for "sweet" gasoline led to the development of a process for treating gasoline to remove the objectionable sulfur compounds, by which treatment some grades of American gasoline heretofore objectionable were made suitable for export.

Under the arrangement by which supervision of the drilling and production of oil and gas on the public lands is vested in the Bureau of Mines, the bureau has supervision of about 100 producing oil properties which are producing at the rate of about 12,000,000 barrels of oil per annum. A special process, devised at the San Francisco station of the bureau, for cracking heavy oils and tars promises the recovery of large yields of gasoline and other lighter products hitherto regarded as unrecoverable. Investigations made by the bureau in Colorado and Utah indicate that the oil-shale deposits of the Rocky Mountain States contain a potential fuel supply of almost unequaled importance.

Packing Perishable Foods in Inert Gas

ARGUMENT is superfluous in support of the proposition that oxygen must be excluded from canned foods of every variety. Until recently there has been equally little argument how to effect this result. Every housewife knows that canned foodstuffs can be so put up as to exclude the oxygen in the first place. At present the ordinary commercial method of achieving this has been to pack the cans, jars, etc., in the presence of vacuum. This process requires heavy machinery; and it is subject to the further inherent drawback of placing on the market a container made with comparatively light seams and under a continual pressure of 15 pounds per square inch.

A new process has been developed of recent months by Messrs. T. M. Rector and Dwight Tenney, which instead of packing in vacuum is based upon packing in an inert gas. Theoretically nitrogen and numerous other gases would be available; practically carbon dioxide is as good as anything else, and far cheaper. It stands to reason that food packed in carbon dioxide will be as free from spoiling as food packed in vacuum. Moreover, taking normal atmospheric pressure as 30 inches, a 28-inch vacuum would contain oxygen to about 1.3 per cent of the normal air capacity of the space involved; whereas, if the air be exhausted and replaced with inert gas, and this process be repeated a second time (double exhaust), the oxygen present is but 0.2 or 0.3 per cent of the normal capacity of the space. At the same time inside and outside pressures are in approximate equilibrium.

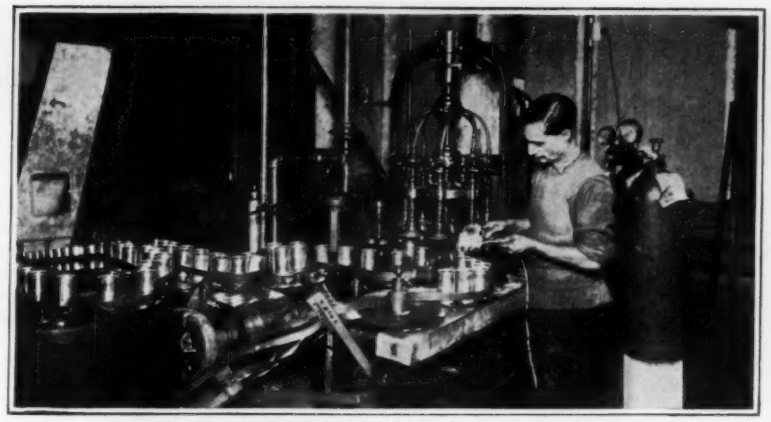
This equilibrium has itself numerous collateral advantages. It permits the sterilization of the contents, when necessary, under steam pressure. It also makes it possible to pack a container of any size whatever, which is far from the case where every face of the container must be a bridge capable of sustaining 15 pounds load per square inch. Moreover, aside from the better elimination of oxygen, the presence of the carbonic acid gas plays itself a beneficial rôle. This gas does *not* destroy micro-organisms; but it does to a very large degree inhibit the growth which can easily be supported, in its absence, on the residual oxygen left by any commercially practicable method of exhaust.

The exhaustion of the air and its replacement by carbon dioxide, however, is on the face of the returns a process calling for machinery of a rather ingenious order. Our photograph shows that this demand has been well met. The cans come from the sealing machine with a small hole remaining open in their tops. They are carried by conveyor belt, without human handling, and placed one after another under the working heads of the gas machine—one can under each head.

These heads appear in our photograph arranged about the circumference of a circle at the right of the operative. It will be observed that each head carries a spring. This enables the head to come down hard on the top of its can, and grip it in an air-tight grip. The head then travels about the circle until it has completed about three-quarters of a revolution. It then releases the can, which is swept out of its path by an ingenious cam action and passes to a discharging conveyor.

It is while the can is in the grip of the working head that the air is exhausted and the carbon dioxide filled in in its place. Two pipes lead to each working head, one coming out horizontally from the central upright around which the instrument revolves, and one swinging down in a curved line from above, as seen in the view. One of these tubes to each working head carries vacuum, the other carries carbon dioxide. The vacuum works during the first part of the can's swing around the circle; it is then automatically cut off and the carbon dioxide feed comes into play, the gas flowing from the cylinder seen at the right foreground. Both exhaust and intake work through the little hole left in the top of the can.

As soon as the air is out and the dioxide is in, the can reaches a point in its travels where the working head automatically releases it, and it is pushed off to a second conveyor, which carries it past the operative. The latter seals the hole with his soldering iron and a dab of solder; the dioxide is sufficiently heavier than the air to insure that no significant amount of it will escape from the can during the moment between its release from the intake tube and its sealing. This hole is of such diameter the can may usually stand in air for one minute, or more, before sealing. And that is all. The machine is producing daily, under actual factory conditions, over 25,000 cans, filling them so that the air space contains less than 1½ per cent of oxygen, with the balance CO_2, nitrogen, etc. The cost, including all labor and materials, is less than 0.1 cent per can. It might seem that in the case of foodsuffs in which the particles may be smaller than the vent in the can, the exhaust tube would clog after a while and the machine have to be shut down for cleaning; but no serious trouble of this sort has been met.



Packing perishable foodstuffs in carbon dioxide

This process has been tried out with a large variety of foodstuffs. Dry milk, chocolate, cocoa, flour containing shortening, nuts, coffee, semi-dried fruits, crackers, bonbons, and the whole list of vegetables, etc., which are ordinarily met canned, have been put up in this way with universal and, in many instances, surprising success. Wherever there are fats present, or fresh, delicate flavors or odors, these remain unchanged to a remarkable degree. The writer sampled various kinds of nuts and fruits which had been in the cans for six months, or even longer, and in some instances would not have been able to testify that they were not fresh.

Washing London Fog Out of the Atmosphere of a Motion Picture Studio

By Major Charles H. Bell

IT is a wise old adage that defines necessity as the mother of invention. And though they also say you can make a virtue out of necessity, it is more profitable to turn it to some useful account.

It was in the memorable October of last year, when London was visited by a period of fog which could have been of pleasurable interest only to the foreign sightseers, that production at a London cinema studio was held up for no less than a week, because climatic conditions made photography a matter of sheer impossibility. Work was going on on a big production, and the firm could not afford this enforced cessation of activities. It is true they had seen the possibility of such handicaps and had thought to cope with them with a certain degree of success by a system of condenser pipes. To an extent they managed by means of this system to clear the fog out of the studio last winter by practically sealing up the building 24 hours before starting work. But even then this necessary suspension of work entailed a considerable financial loss, as it meant days of enforced idleness for the entire production staff.

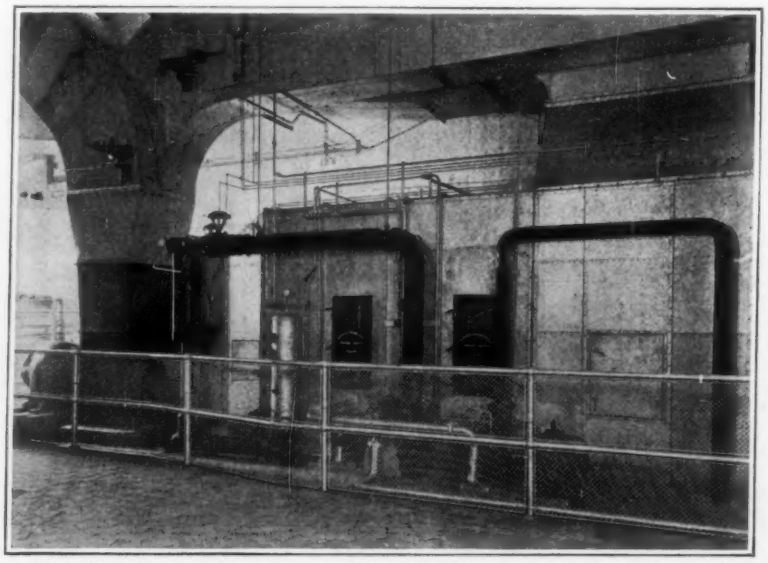
This and like experiences brought the realization right home that the British motion-picture industry could hope to carry on its work during the entire year only by grappling to some effect with this serious climatic process. Mr. W. C. Riley, who for 20 years has been chief architect to the London County Council, and who is responsible for the installation of the largest ventilation system in Great Britain, that in use on the London Underground Railway, was therefore called to their assistance. After a series of consultations and preliminary experiments with certain devices, it was found that a practical installation could be built to effectually deal with the fog exigency—a plant that would remove all fog from the studio, maintain therein a given temperature and a certain percentage of humidity, and cool the studio to within 18 degrees of outside wet bulb temperature.

The entire apparatus is automatically controlled, and is so sensitive in response that the lighting of the arc lamps in no way influences the temperature of the studio, which without the apparatus would in this way be raised from 10 to 20 degrees. The plant is designed to circulate three and a half million cubic feet of washed pure atmosphere per hour. This air is drawn from outside or recirculated from inside as required.

The air is admitted to the humidifier through a series of baffle plates, so arranged as completely to break up the incoming air and do away with pockets which can otherwise be formed. The air then meets the first bank of sprays, consisting of 220 sprays fed by a two-inch water supply direct off the main. During the winter months the temperature of this water is 35 degrees Fahrenheit. A fogged atmosphere coming immediately in contact with this chilled water condenses and forms a saturated atmosphere.

A further series of 186 sprays is fitted three feet behind the first bank. These are maintained with a very high pressure of water supplied by a centrifugal pump driven by electric power, which water is circulated from a main washer tank at a temperature to maintain the correct dew point. The air, after passing the second bank of sprays, comes against the eliminator plates, which are so designed as not to allow any particle of air to pass without meeting with a series of definite obstructions. The plates are washed with a separate supply of water at high pressure, so that every particle of foreign substance is eliminated.

After this procedure the air is brought into contact with a series of heating banks, heated by steam from low-pressure boilers in the basement of the buildings. This steam is controlled in the same way as the atmosphere, so that only the correct percentage of steam is admitted to the banks, in order to give the temperature required and called for on the thermostatic boards on the studio stage.



Humidifier for washing the atmosphere in a London motion-picture studio, showing main fresh-air trunk leading to the two stages

A main centrifugal fan distributes the air to the studio itself through a series of ducts with downcomers fixed at certain intervals along the walls of sufficient proportion to admit the requisite quantity of air with little or no pressure.

The chief object of the distributing system is to maintain at all times a pressure slightly greater than the normal outside pressure, and by this means to create a tendency in the atmosphere to leak outward from the studio, as against its normal tendency to penetrate *within*. By this means it will be seen that on foggy days there will be no necessity in future for the studio to be sealed up against the incursions of that arch-enemy of good photography. From the tests already made, the plant has entirely justified expectations. Without such a perfected system of air-washing it would be without a doubt impossible to produce pictures in England on an American scale and maintain a large studio organization during the winter months.

With the use of the air-washer it has become a matter of course to operate in this way.

A Ship Wit a

How the "F. D. Asche" Was Towed fro da t of Compressed Air to Keep Out

By Rob errett

The "Asche" in drydock. This view is taken from within the hull, looking out through the hole torn out of the ship's bottom

THE salvage of the oil tanker "F. D. Asche" a while back is another example of up-to-date wrecking methods applied skillfully under circumstances that would probably have staggered wreckers resorting to ordinary facilities. In fact, but for the course pursued, the ship would probably have been deemed a total loss, for to have refloated her otherwise would have entailed disproportionately heavy outlays in labor, material and time. The "Asche" is a craft of 11,790 tons deadweight capacity, built less than four years ago, and constructed upon what is known as the Isherwood system. The vessel is fitted with nine athwartship bulkheads, and throughout the cargo space the compartments so formed are subdivided by a central fore-and-aft bulkhead. In other words, each of the capacious oil tanks has a breadth of 30 feet, a length of 20 feet, and a depth reaching down the whole distance from the upper deck to the ship's bottom. These details are mentioned in order that it may be easy to grasp just what were the volumes of water entering the tanker when the plating of her underbody was ruptured.

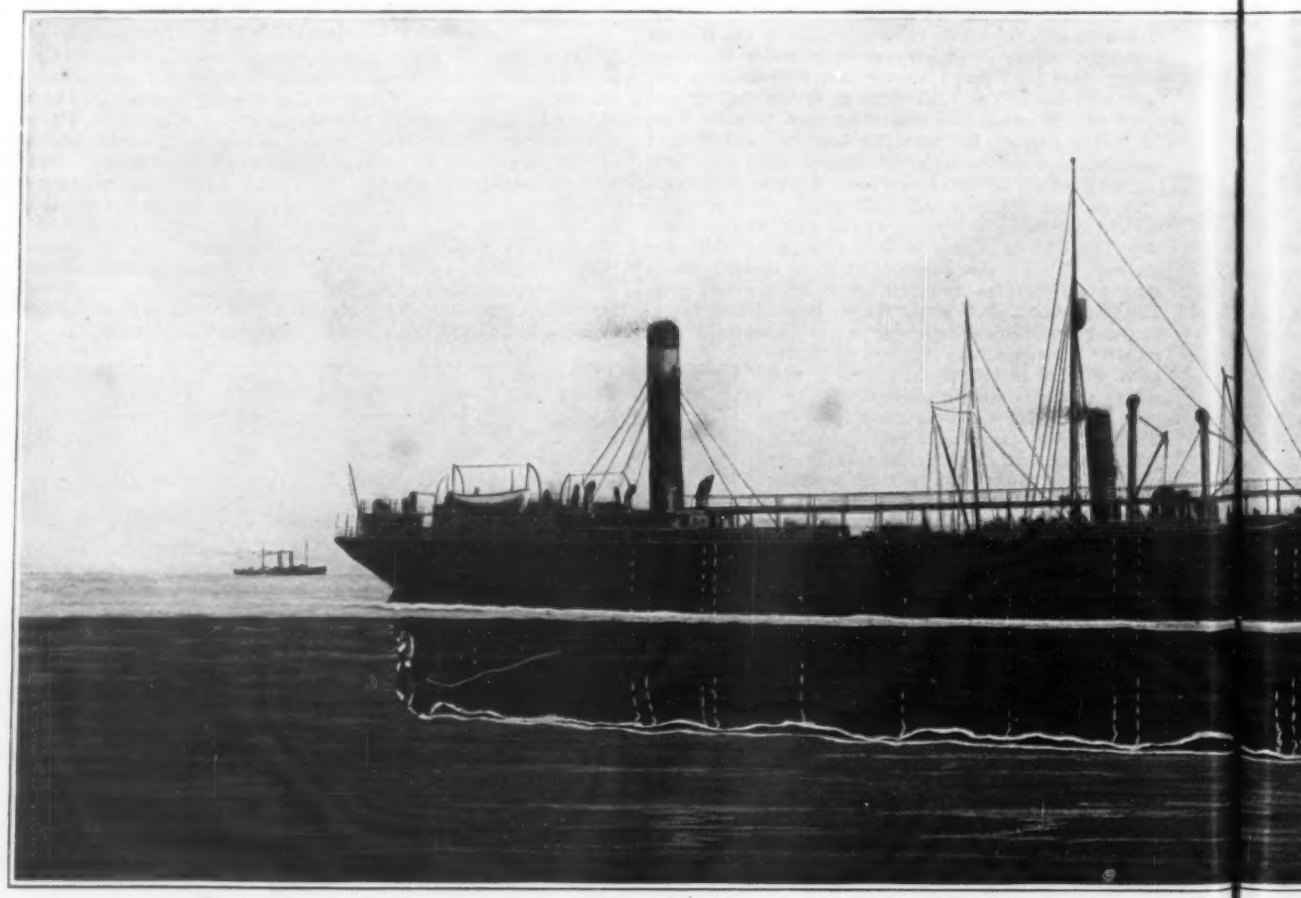
The steamer left New York City in ballast the latter part of October, bound to Texan ports to load with crude oil. Three days later, while feeling her way toward the Straits of Florida, her navigator received warning of a hurricane moving northward from the neighborhood of Yucatan Channel; and in the course of 48 hours, while cruising slowly and holding her position well off the Florida coast, the storm struck her in earnest. The weather was so thick that the tanker was headed to the eastward, and for a number of hours was driven at full speed farther out to sea; but fearing that she might run across the main path of the tempest, the "Asche" was swung around and allowed to ride out the gale, hove to. When the wind moderated sufficiently, the "Asche" was pointed to the south and west, and she was pushed cautiously forward while trying to pick up soundings on the coast of Florida. No observations had been made for a number of days, but dead reckoning indicated that the tanker was about three miles to the northward of Matanilla Reef and close to the Bahama Islands.

Nothing untoward happened until very early in the morning of the 27th of October, shortly after no bottom could be found at 85 fathoms, when the "Asche" suddenly grounded. To keep her from pounding and further damaging herself, her engines were stopped, all of her tanks flooded, and both of her anchors dropped to hold her where she hit. When daylight came, the dry reef could be seen half a mile ahead with the seas breaking heavily upon the rocks. Later it was found that the ship lay just inside the outer line of Matanilla Reef and in water five fathoms deep. By that time the sea had forced itself into the fuel tanks and was putting out the fires under the boilers. S.O.S. radio messages were broadcasted for assistance; and while other craft in the neighborh these proceeded to her relief they could do nothing to alter h of the predicament.

When the weather altered so as to permit of an exa ncy. ination, a brief survey disclosed that two-thirds of t ents; steamer's bottom was injured if not torn away entire that i A subsequent survey showed the bottom plating of st ead a board tank No. 4 to be detached, and hanging only by ng was forward connections, so that persons standing on deck a dion. looking through the open hatch could see right down i ile st the sea. The pendant plating was caught in a crevice the underlying ledge, and thus served to tie the craft ir-lock the reef. The bulkhead at the forward end of this ta —the was crumpled up at its lower edge and fractured whe betwe bent. The question was how to deal with the situati with s and to get the "Asche" out of her dangerous position wi compa all practicable dispatch. Haste was necessary lest t that i ship be overwhelmed by another storm and destroyed. This

The salvage master, representing a well-known wreckin ; and company, decided on the 30th of October that the tank ship lig could best be handled by means of compressed air, a mpress for that purpose air-locks and compressors were dispatche by w to the scene of the wreck to help in refloating the cra r the On the 9th of November the first attempt was made werful release the ship; and the salvors were actually able e 11th move her about six feet; but there she stopped becau starte of the grip which the ledge had upon the hanging bott d to t plating of starboard tank No. 4. It was essential to brea of h this hold before trying again to shift the tanker. At s. As inconsiderable hazard divers managed to attach a hea y repa purchase to the submerged steelwork, and the sturdy ca to essa was then led to a powerful steam winch. In this way York pull of possibly 100 tons was exerted, and the anchor e 1st bottom plating was drawn free and brought up approx effect, mately to its normal position and secured for the ti m, for being by lengths of strong chain. inver

Up to this point the forcing of compressed air into t held flooded oil tanks sufficed to drive the water down a each out generally to within four or five feet of the vesse still bottom; but this showed that there were many leaks by t the battered skin, and it was necessary, as far as feasib tion u



The irregular white line shows the damage done to the bottom of the oil tanker "Asche" by pounding for several days on "Strange hama Is

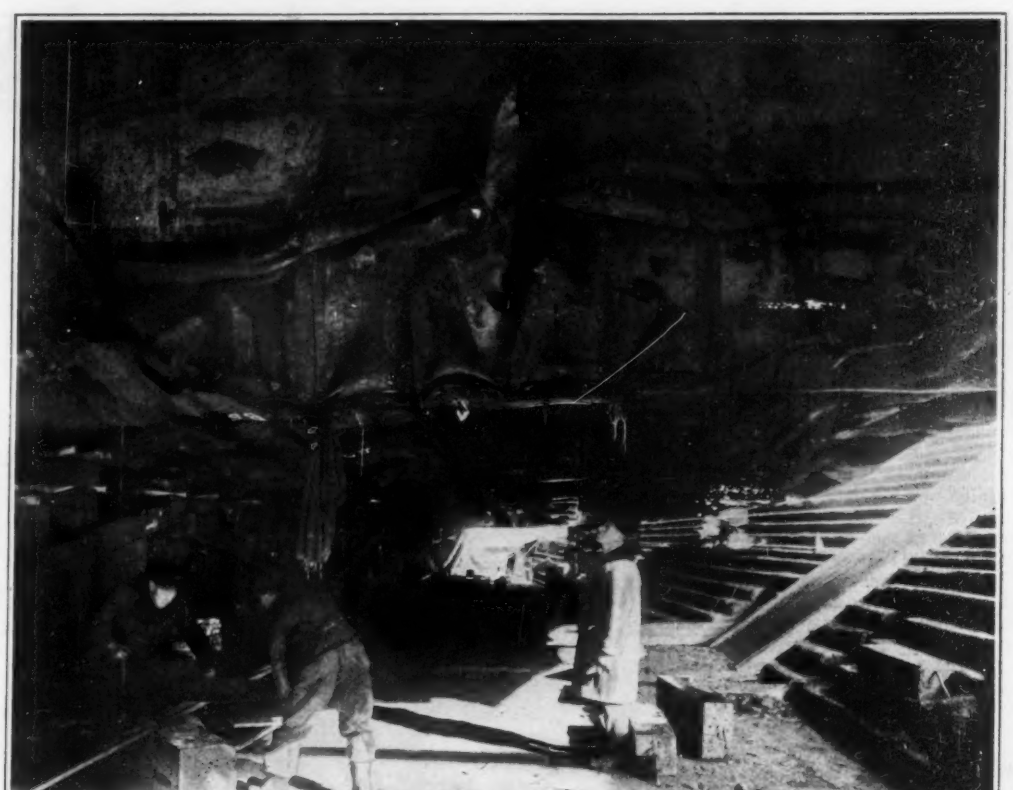
Salvage Asche"

Wit a Bottom

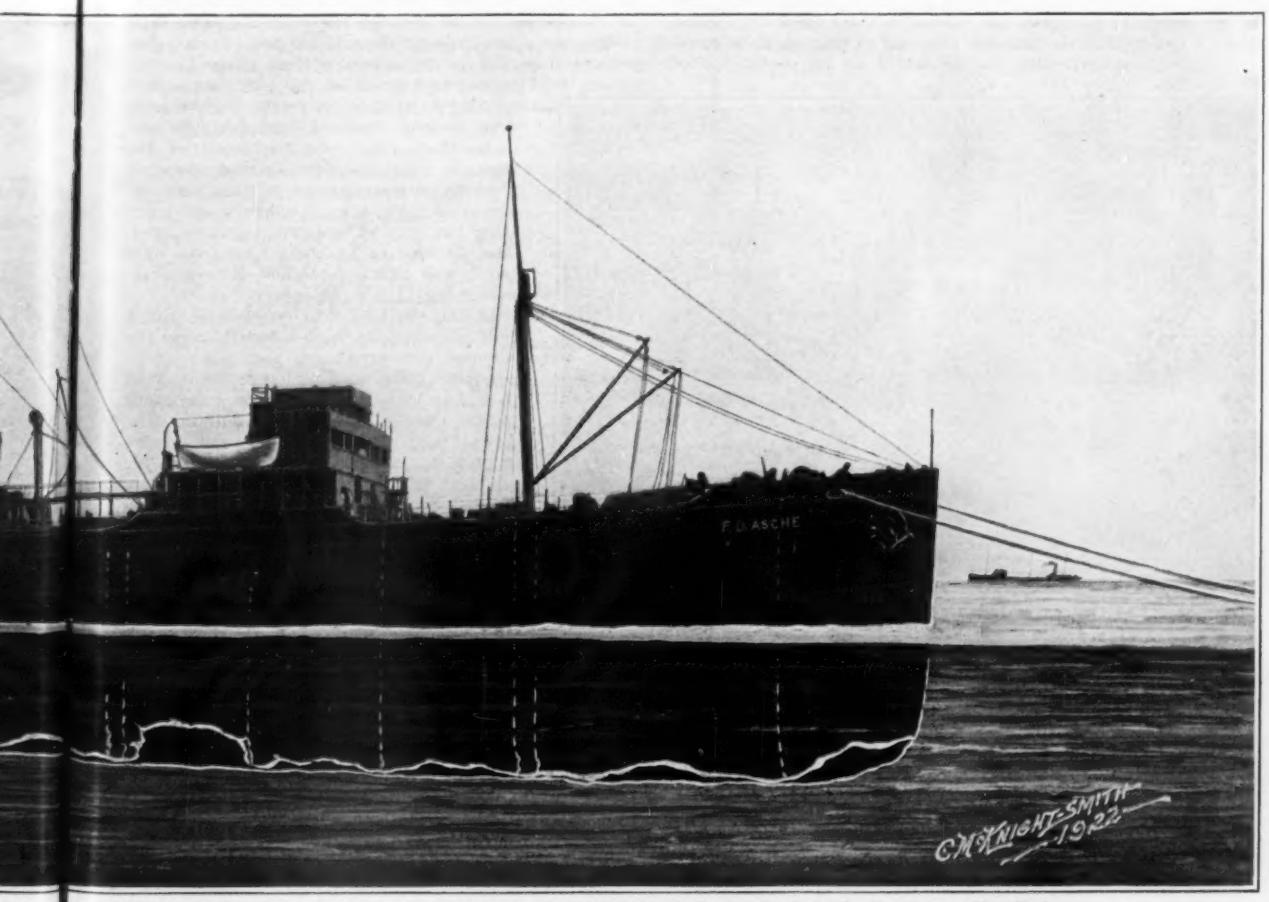
wed fro da to New York with Only a Blanket to Keep Out of Her Gaping Hull

By Rob errett

neighborh these should be closed—working from the upper
g to alter i of the injuries downward so that the air could push
ore and more water in order to increase the available
of an exa ncy. This was effected by men sent into the com-
thirds of ents; and the most troublesome phase of their task
way entire that involved in dealing with the fractures in the
ating of st ead at the forward end of tank No. 4, where the
g only by ing was doubled on itself somewhat like a fold of an
on deck a dion. The difficulty was finally overcome.
ht down i ile starboard tank No. 3 was filled with compressed
a crevice the men passing down into that compartment through
the craft ir-lock temporarily attached to a hatch on the upper
of this ta —the salvors gradually plugged the ruptured bulk-
ctured whe between tanks Nos. 3 and 4 by plastering the open-
the situati with successive layers of newspaper. The compressed
position wi compartment No. 3 was of a slightly greater pressure
ary lest t that in the neighboring and more seriously damaged
lestroyed. This pressure served to hold the plastic sheets in
wn wrecki ; and thus the water level was gradually lowered and
t the tank hip lightened correspondingly.
sed air, a pressed air was also fed to all of the flooded oil
e dispatch by way of their regular pipe lines; and sufficient
g the cra r the whole salvage service was furnished by a group
as made werful oil-driven compressors. Early in the morning
ally able e 11th of November, about a week after operations
ped becau started, the "Asche" was floated clear of the reef and
ging bott to the shelter of a cay not far away, where the
ial to brea of her bottom could be inspected thoroughly by
ker. At t s. As a result of their examination additional tem-
ch a heav y repairs were made, and the steamer put in a condi-
sturdy cal to essay the journey northward. She was towed to
this way York and reached that port without further mishap
e anchorig e 1st of December.
up appro effect, the "Asche" was virtually like a ship with no
r the tim m, for her injured compartments were akin to so
inverted tumblers or diving bells—the intrusive sea
air into t held at bay by the volume of compressed air with
down a each chamber was continually filled above the line
he vessel still gaping wounds or breaks. This air was sup-
y leaks b by the salvage compressors that worked without
as feasib tion until the tanker was finally brought to rest upon the blocks of a New York dry dock. When the dock was unwatered it was possible to see just how grievously the coral reef had wounded the ship. The heavy plating of her bottom, from bow to stern, was successively indented until the steel skin formed a series of metal waves with ragged holes and open seams here and there. The worst damage, as we have said before, was at starboard tank No. 4, where, besides the torn bottom, the side plating was ripped and crushed to a height of eight feet above the keel. These visible evidences of her battle with the storm showed the manner in which the steamer was driven by the seas over the ledge and repeatedly dropped upon the underlying coral formation before coming to rest.



Beneath the bottom of the "Asche." View in drydock after she had been brought up from the West Indies, showing crumpled condition of bottom plating



Strange hama Islands. The ship was floated by forcing air into her oil tanks, and upon these tanks she made the voyage to New York
lvage "Asche"

Lost in Transit

SOME months ago we commented editorially upon the careless habits of the American shipper, and told how an organized campaign by the Pennsylvania Railroad to educate the public and the transportation employees had resulted in a material decrease in the number of lost shipments and claims against the company. The American Railway Express Co. shows us a tabulation of similar results, over a period of 3½ years.

The great evil with which the Express Company has to contend is packages found in terminals or on its lines with the marks missing or illegible. This particular variety of carelessness reached a high point in August, 1918, when no less than 33,000 such shipments were turned in to the "No Mark Bureaus" of the Company, of which it was necessary to maintain 20, with 213 employees. This volume of unidentifiable shipments was abnormal, and is doubtless to be attributed to the very low caliber of the assistants in many shipping departments at this period. By March, 1919, the number of No Mark Pieces was down to 8000, which seems to have been about normal, since it represents an average that was nicely maintained until October, 1920.

At about the latter date the company began an intensive campaign of education, trying to induce the shipper to be more careful, and the receiving agents in the express depots to be more exacting in imposing standards of proper marking. The number of unmarked pieces turning up on the lines at once suffered a further drop, and by May, 1921, had fallen below 1500. It has remained in this neighborhood ever since, and the Express Company now maintains only nine bureaus to take care of these packages.

At the same time the number of claims of all sorts presented against the company has dropped from a high mark of 242,000 in January, 1919, to 50,000 in September, 1921. This means a fall from 14.5 claims per thousand shipments to 3.25 per thousand. The saving to the company in actual indemnities and in expense of tracing shipments is matched by the saving to the shipper and the consignee.

Tons of Silver from Waste Hypo

An Interesting By-Product of the Present-Day Motion-Picture Industry

By Charles Alma Byers

IT is a fact of universal knowledge, of course, that the motion-picture industry is responsible for a product which sells to the public for millions of dollars in minted silver monthly. It is a fact known to comparatively few, however, that it also yields each month a by-product of bar or unminted silver worth thousands of dollars. The industry, in other words, not only is a "silver mine" figuratively speaking, but also is responsible for silver mining, of a kind, in the literal sense.

This by-product branch of the motion-picture industry, be it known, owes its existence to the use of silver in the manufacture of film for motion-picture purposes. The "coating," or emulsion, of the film, both negative and positive, contains, for instance, a considerable percentage of silver; and in "developing" this film, which is done in a solution called hypo, much of this silver is naturally removed and thus made to comprise a deposit in the hypo bath. After a time this solution reaches the point where it is so heavily impregnated with the silver and other emulsion ingredients that it must be discarded, when it becomes so-called laboratory waste. The reclaiming of the silver from this waste is accomplished by various simple processes, and constitutes a business of quite exceptional interest and of not a little importance.

Precipitating silver from waste hypo, however, is not a new discovery or new practice. It has been done by photographers for something like fifty years, but naturally never before has it been done on anything like so large a scale as the great growth of the motion-picture industry now makes possible. And in and about Los Angeles, California, where is largely centered the production end of the picture business, this side-line industry, that of reclaiming silver from film developer, has, as a matter of course, been brought to quite exceptional development. Some three or four firms, for instance, are exclusively engaged in the work, in that city alone, and their product, it doubtless will be quite surprising to learn, amounts to on an average of something like a half ton of pure silver each month.

By way of bringing the possibilities of this by-product industry clearer to mind, it is estimated that the motion-picture studios in and around Los Angeles, when operating to normal capacity, use about 12,000,000 feet of film per month, and that in the developing of this film the use of approximately 30,000 gallons of hypo solution is required. The recoverable silver represented in the foregoing figures is estimated in two different ways. On the footage basis, it averages a little more than 800 ounces to each million feet of film, which means a total per month of about 9600 ounces, or, by troy weight, 800 pounds. The quantity of recoverable silver to the gallon of waste hypo naturally varies very extensively, for some laboratories permit their solution to become much richer in emulsion deposit than others. The range, in fact, is all the way from .20 ounce to over an ounce to the gallon, but the average is put at about a third of an ounce. By this method of figuring it is seen that the normal average of recoverable silver from the waste is approximately 10,000 ounces per month. In addition to this, however, there is, as will subsequently be shown, a small quantity of silver that is recovered from the film in a somewhat different way.

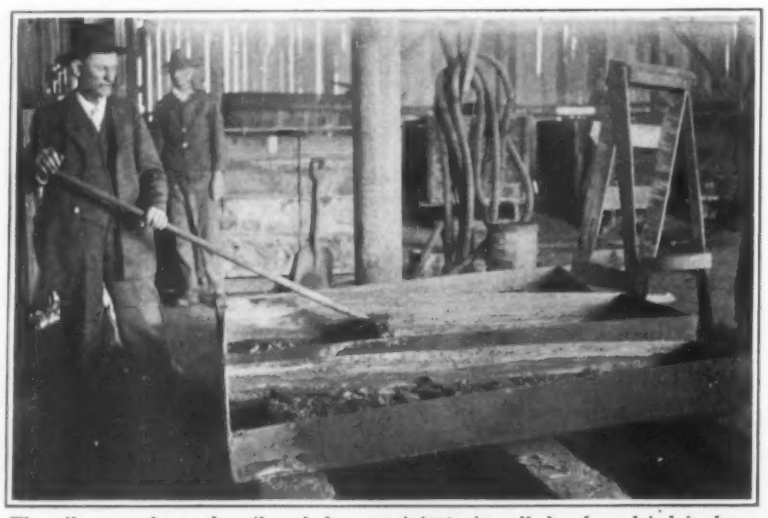
Perhaps, before proceeding to an explanation of how this silver is reclaimed from the waste hypo, a brief description of how motion-picture film is made will prove generally interesting. Shorn of technical parlance, the film, it may be stated, is manufactured by making a pulp of cotton by a chemical process, into which pulp camphor is then rolled by powerful pressure. Raw or uncoated film is the product. A thin coating of glue is now applied to one side of the film, the result being called emulsion. Silver dissolved in acid, thus becoming known as silver salt, is next applied to this coated side of the film, with the result that a sort of chemical mirror, or sensitized surface, is created. Exposure through the camera lens now will cause the image or the picture to be registered and retained thereon, through the mere action of light. The silver salt touched by the light or light-rays, to put the matter more plainly, is chemically changed and thereby rendered insoluble in hypo, which, technically, is sodium hyposulphite. After the image is "fixed" or developed by organic chemicals, hypo is used to dissolve and remove the excess or unaffected silver, with the result that the parts of the film on which the light-rays of the image have registered are rendered in varying or relative degrees of opaqueness. Approximately a half of the original silver is, in the process, dissolved and hence left in the hypo bath.

Tanks in which the waste hypo is stored and treated with a silver precipitant

To reclaim this waste silver is naturally no very difficult task. After being removed from the laboratory hypo tanks and transferred to other large tanks in the various so-called photo-metal refinery plants, the first act is to precipitate or otherwise mass the silver, which means that the solution must be so treated as to cause the foreign matter in the water, or its percentage of silver only, to either settle to the bottom or be congealed into a mass. This is accomplished in several different ways. One way is to direct through the solution a current of electricity, by means of which the silver ingredient will be made to form itself into a coating on a metal plate, as in silver plating. The more common method, however, is to treat the solution chemically, which may be done with some two or three more or less different preparations.

Sodium sulfide is perhaps the most generally used in the precipitation process. It will be used in the proportion of one pound to about twenty gallons of waste hypo solution, and approximately ten days must be allowed for it to complete the precipitation. Caustic soda, attended by some method of heating the mixture, is also quite commonly employed as a precipitant, and, when used with heat, will bring about the desired result in about one day. There are, of course, still other treatments, common to handling hydrated silver, that are employed occasionally, but which need no detailed mention here.

When once the silver, together with the other foreign matter, has been precipitated in this manner, the water is drawn off, and in the bottom of the tank will then be found a heavy, coal-black mud, commonly and quite appropriately referred to as "silver mud." This mud is subsequently removed and usually placed in large flat trays or pans over a slow fire, to dry. When thoroughly dry, it is broken up and, perhaps, stored in sacks until it is melted down. This silver mud, when dry, ordinarily contains about five ounces of silver to the pound mass. It is subsequently subjected to furnace heat, of about 2000° Fahrenheit, which results in the melting of the silver and the elimination therefrom of the waste matter. The silver is then molded into ingots, of the usual forty pounds each, and later disposed of to the United States Mint at San Francisco.



The silver mud, as the silver-laden precipitate is called, when dried in large pans over a fire, assays five ounces silver to the pound

Another source of recoverable silver from motion-picture film has been referred to above. The film, or at least much of it, reaches the producing studio from the manufacturer without the sprocket punch-holes along the two edges which must be provided, in both negative and positive film, to equip it for reel manipulation. These holes are, of course, punched by machinery, and the tiny particles of film removed from the millions of footage in this operation accumulate most surprisingly. One of the Los Angeles companies engaged in this waste product business, for instance, reports that it has received as much as two tons of these punched-out particles in one month. The silver from this waste is recovered by the simple process of burning the particles, and then putting the ashes through the melting pot. Such ashes produce from five to six ounces of free silver to each pound, and a ton of the particles before burning is said to be worth from a hundred to one hundred and fifty dollars. More than this, even the wood of the tanks in which the hypo is used or stored becomes so impregnated in time with silver as to make the old tanks worth more than the cost of constructing new ones. And in recovering the silver from this wood the burning method is again resorted to.

It may be added in conclusion that a half ton of pure silver—approximately the amount recovered each month as a by-product of the motion-picture industry in Los Angeles—is sufficient to coin about 13,950 United States silver dollars. The hypo "refiner," however does not receive a price for his product on this basis, for he must sell his silver at the market price—for so-called "foreign" silver. And a quite remarkable statement that may be made in this connection is that, until three or four years ago, all the silver-laden waste hypo produced by the motion-picture studios of Los Angeles went into the city sewers or was otherwise discarded, as being of not sufficient value to be worth the trouble of attempted recovery.

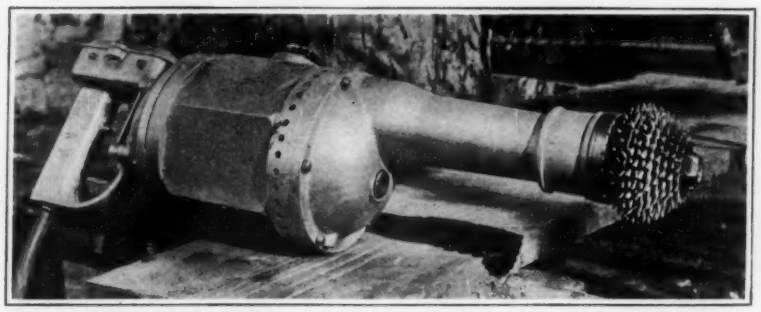
Liquid Air for the Laboratory

IN a recent publication, Scientific Papers of the Bureau of Standards, No. 419, entitled, "The Production of Liquid Air on a Laboratory Scale," the design and construction of apparatus for the Hampson process is described. Brief descriptions of necessary or useful accessories are included.

This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to this Bureau until the free stock is exhausted.

A Drill for the Tree-Dentist

TREE surgery has often been compared to dentistry; on its face, the expression "filling a tree's teeth" is descriptive of what the tree-doctor does when his arboreal charges develop rotten zones. The latest tool which has been put at his disposal makes the tree-doctor even more like the dentist in his procedure. We all know from sad experience the thoroughness with which the latter worthy excavates in preparation for his fillings, in order to be absolutely certain that he shall not put the latter in on top of any putrid matter. The tree-doctor has had to do his best to imitate this care with rather clumsy tools—chisel, saw, adz. But now there is provided for him a machine that is in every respect the counterpart of the electric drill of the dentist, and that attacks rotten wood in just the way that the dental drill attacks decayed tooth-tissue. Indeed, one can hardly resist picturing the tree as the giant possessor of a giant tooth, on which this giant drill is at work; or visualizing the operator as standing over his arboreal victim, instrument of torture in hand and cheerful smile on his face, the while he admonishes his patient to "Open wide."



This modification of the dental drill, for use in cutting rotten wood out of hollow trees, is so large that the head is assembled from circular-saw blades

The tree-drill is operated by a 32-volt, fan-cooled motor with pistol grip, trigger switch control, and a speed, without load, of 38 revolutions per minute. Its total weight with all connections is less than twenty pounds. The patent burr differs from that of the dental drill in that it is assembled, instead of being cut from a single piece of metal. It is made up of eleven tool-steel circular-saw blades, so set on the shaft that the teeth alternate. These blades are easily removable for sharpening. This device, invented by F. A. Bartlett, of Stamford, Conn., marks the successful solution of a problem with which tree experts have been struggling for a dozen years or more.

Auto-Bus Stability

AUTOMOBILE busses of large capacity are among the most unwieldy things known to the human race, so far as appearances go. It does not seem possible, looking at one of these huge carry-alls in motion, that it can be stable; one gains the impression that every turn will be a turn-over. One knows better, of course; there is nowhere in the world of motor busses a model that looks more utterly unbalanced than New York's Fifth Avenue busses, yet in fourteen years there have been but two overturns of these, both resulting from a driver's effort to make the bus stand on its tail and spin in order to avoid a collision with a car recklessly shot out of a side-street. Nevertheless, it does not seem possible, regardless of what reason may dictate, to convince the eye that these and others like them are really stable.

We present an interesting picture designed to overcome this instinct, if it be capable of overcoming. Loaded with 150-pound sandbags to represent its full complement of passengers, one of these busses was tilted to the angle shown without disaster. The tread of this bus is of such width that the inclinometer reading of 35 degrees, visible plainly over the cowl, means that the center of gravity is no more than 52 inches from the ground. If it were any higher than this, its projection upon the ground would fall outside the wheels at this angle, and the bus would capsize. It is claimed for this coach, the latest model put in service on Fifth Avenue, New York, that its center of gravity is lower than in any motor bus heretofore designed. The truck maker has a good start in his pursuit of steadiness, since the heavy frame and much of the heavy power-plant come naturally low in the assembly. But a performance like that illustrated deserves great credit, for all that.

Big auto-bus tilted sidewise at angle of 35 degrees, to demonstrate that its center of gravity is within 52 inches of the ground

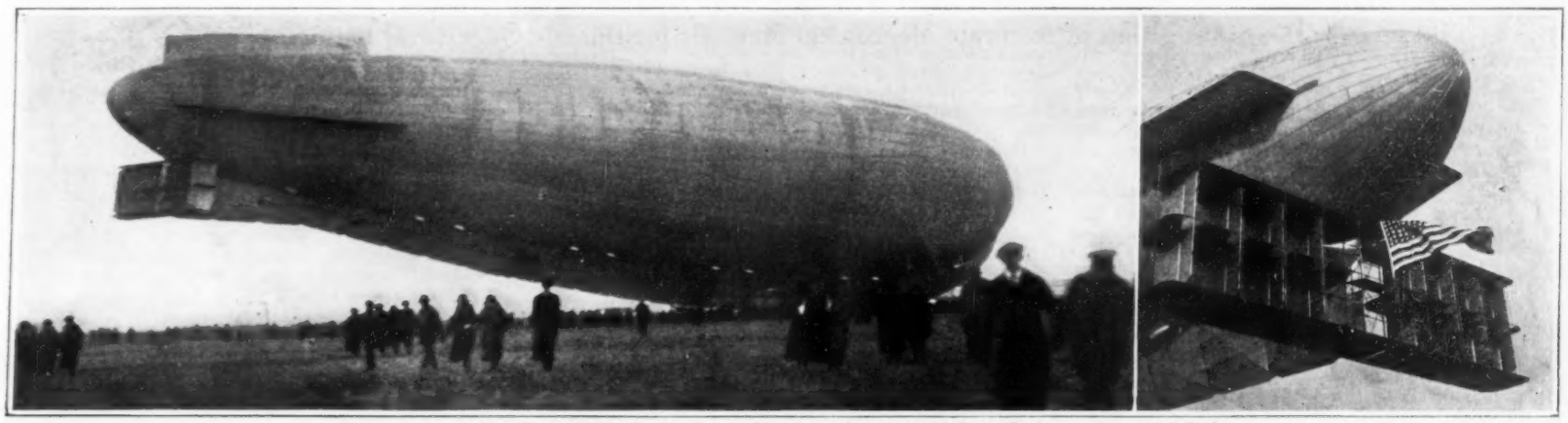
America's Latest Airship—"Roma"

THE largest aircraft ever flown in this country—the dirigible, "Roma," acquired by the United States from Italy—was subjected to its initial flight recently at Langley flying field, Virginia. The huge air-going machine has a length of 418 feet, carries 1,200,000 cubic feet of hydrogen gas, and travels at a rate of 80 miles an hour. With the replacement of its motors of Italian design with six 12-cylinder, 400-horsepower Liberty motors, the cruising radius of this dirigible will be enlarged to the extent of making possible a non-stop flight from the Atlantic to the Pacific Coast.

The "Roma" was built by the Italian government in Rome, Italy, and purchased by the United States government at the termination of the war. Its dimensions approximate those of the Zeppelins employed by Germany in raiding London and not quite so large as R-34, the dirigible detailed by England to cross the Atlantic. The size of the "Roma" is further emphasized by citation of the fact that there are only five hangars in America capable of accommodating this air-going structure. For example, the hangar at Wingfoot Lake Air Station, Akron, Ohio, is 400 feet long, a capacity which would leave the nose of the airship projecting outside of the door. The airship is 82 feet wide, 88.6 feet high, and is capable of transporting a useful burden of nineteen tons.

The maiden journey of the "Roma," after being refashioned and reassembled in the United States, was not without mishap, although of trivial consequence. After being in the air for slightly in excess of one hour, the propeller blades on the left forward motor were shattered when a tiny aluminum door on the engine compartment fell into the propeller. Fragments from the damaged member ripped a big hole in the keel cover, and, also, perforated a series of small openings in the lower diaphragm of one of the gas compartments. Exercising a presence of mind commensurate with his responsibility, the technician on board the aircraft suspended the activity of the engine as a means of lessening a fire hazard. Gas was valved out of the damaged compartment to relieve the pressure while repairs were being made. Three persons were rendered temporarily unconscious by the hydrogen gas inhaled. The dirigible, however, continued to function in absence of the activity of the forward motors, and the flight, begun at 9:40 A. M., continued until 1:12 P. M. when the huge mechanism was again brought to earth.

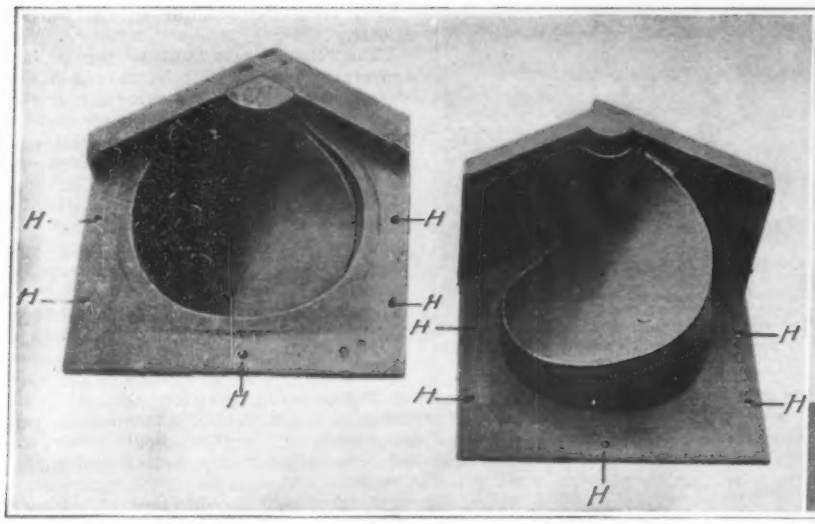
Radio-telephony and radio-telegraphy communications were maintained with the "Roma" from the Langley flying field throughout the three hours of flight, designed primarily for purposes of inspection. Amateur wireless operators followed the fortunes of the airship, and received information of the mishap to the propeller soon after its occurrence. The operating crew and passengers, all told, numbered 31 persons. When first taking to the air, the dirigible was free ballooned to a height of 400 feet, the gain in altitude being gradual as its pathway headed in direction of the Chesapeake Bay. The flight, for the most part, was made at an elevation of 200 meters. The Air Service of the United States Army contemplates a cross-country test flight in the near future, the plan being for the big dirigible to cross the Appalachians into Ohio.—*By S. R. Winters.*



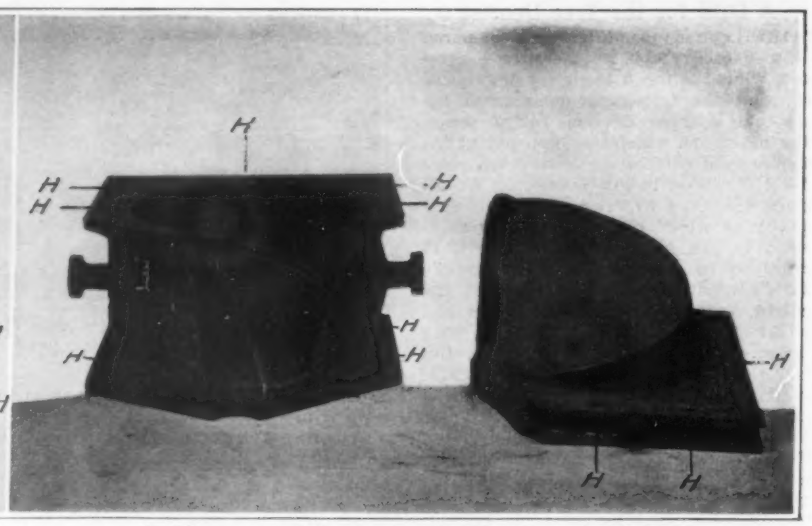
Two views of the "Roma," Uncle Sam's airship recently acquired from Italy, on her trial flight

Building-Material Prices

THE Bureau of Standards has recently prepared a table giving prices on the more important building materials as of December 1st, 1921. This shows the prices in various cities of such commodities as brick, portland cement, lumber, lime, sand, stone, glass of all sorts, pipe, paints, varnishes and roofing materials.



1. The pattern plate and pattern, and the Cope container and pattern



2. The cope, and the drag mold. Note centering holes H for accurate assembling

Exactitude in Propeller Manufacture

The Substitution of Accurate Mechanical Methods for the Old Sweep and Pattern

IT is a strange anomaly that, in spite of the seventy years of development in steamship construction, propellers have continued to be cast by what are broadly the same old foundry methods which were in use when the first steamship crossed the western ocean. It is only of late years that the Thacher process, which is used in making the propellers for our Navy, has furnished the art with the means of casting propellers which are so true to form and design that no machine-work is required upon them.

Progress in Propeller Design

The completely successful propeller must be designed to suit the conditions of the vessel it is intended to drive; it must be constructed absolutely true to the designed requirements, and it must be of a strong and durable non-corrosive metal. The advent of the Model Tank Basin has made it possible to obtain definite and dependable information as to the power required to drive a vessel of given size and shape at different speeds. The model, usually of wood, is constructed about 1/48 of the full-size steamship; at least, that is the proportion recently adopted at the Washington Navy Yard model tank basin. As the model is towed, the resistance is automatically recorded; and by the application of a certain formula to these data, it is possible to estimate with great accuracy the horsepower required to drive the full-size ship.

Propeller design formerly was based on rule-of-thumb methods; on comparisons between various ships; or it was arrived at by repeated trials of different propellers until a suitable result was obtained. Rear Admiral Charles W. Dyson, U. S. N., devised a method consisting of a series of charts, curves and tables, by which all of the factors of propeller operation can be computed; the resulting design, if the propeller be accurately constructed in accordance thereto, will give the desired efficient operation. However, because of faulty methods of propeller manufacture, poorly constructed propellers have often subjected the designer to unmerited criticism.

Materials in Propeller Casting

The materials generally used in propeller manufacture are cast iron and manganese bronze; although steel, monel metal and other bronze compositions are also used. Cast iron propellers are less costly, but are more susceptible to corrosion. They are used chiefly in fresh water on river steamers, tug boats, barges, and occasionally on ocean-going tugs, tenders, tramps and freight steamships.

Manganese bronze, however, is the usual material for the better class of freight, passenger and war vessels. It has a much higher tensile strength, has longer life by reason of its non-corrosive quality, and has proved to be the best material for the purpose. The tensile strength of good cast iron or semi-steel varies from 25,000 pounds to 43,000 pounds per square inch, with a very low per cent elongation; whereas manganese bronze has a minimum tensile strength of 65,000 pounds per square inch with an elongation of not less than 20 per cent in two inches.

Physical Requirements of Perfect Propeller

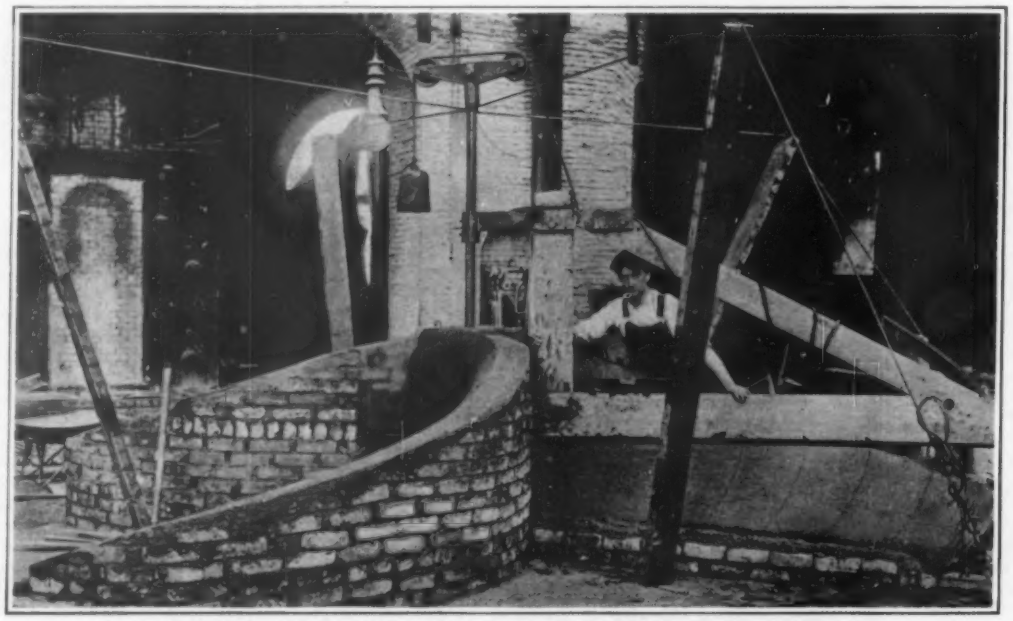
The physical characteristics of a perfect propeller are: accuracy as to diameter, pitch, blade area, surface, and uniformity of metal distribution. In diameter accuracy, the tips of the blades must be equidistant from the propeller center. The pitch must be as designed; but it is of far greater importance that the pitch of each blade be uniformly identical with the pitch of each corresponding blade. This can be accomplished only when every given point in each blade lies in the same relative position to the axis as does the corresponding given point in every other blade.

The two most important elements in propeller manufacture are; first, the uniformity of pitch of each blade with the others; second, the uniform distribution of metal in each blade. It is particularly in these two characteristics that propeller manufacture under the old methods has been found faulty.

Old Method of Propeller Casting

Previously, there were two general methods of propeller manufacture in use, known as sweep and pattern molding. The degree of success in these methods is limited to the skill of the individual molder; nevertheless, the most skilled effort cannot produce a propeller that is absolutely accurate in the essential particulars.

Fig. 3 illustrates a mold for casting a 4-blade, solid propeller, which is here being made by the sweep method. In this method there is set up on the pouring floor a cast iron disk from the center of which projects vertically a round, steel spindle. Upon this spindle is placed a form, representing the hub of the propeller, and on a horizontal arm, or straight-edge, for mold sweeping. Four posts equidistant from the spindle, are set up on the outside of a circle that is slightly larger than the diameter of the propeller, and from these posts four inclines are arranged whose slope represents the pitch of the propeller. On these, the spindle arm is moved to develop the mold pitch. A brick form is built up to represent the pitch or incline, and this form is covered with loam and swept to the true pitch with the spindle arm. This constitutes the bottom half of one blade mold. The cope or top half of the mold is constructed on the same general principles, and after the two halves for each blade have been thus formed, and baked in the oven, they are assembled and the pouring of the molten metal is performed.



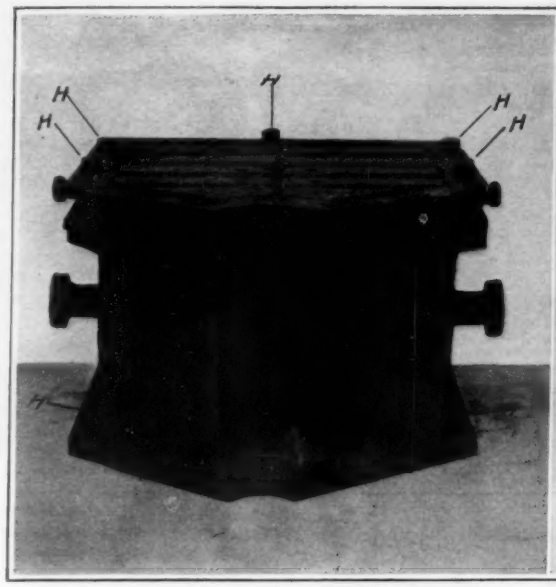
3. Preparing the mold for a 4-blade propeller by the sweeping process

In the pattern method, the operations are broadly similar, with the difference that when a pattern is used it is constructed for one blade and hub set over the central vertical spindle; and the pitch incline and sweep arm are not required. It will be readily appreciated that this is not an exact method of molding, since each blade is separately constructed under different individual set-ups, and the errors of each blade are correspondingly individually different. Consequently, in Navy practice there is allowed on the surface of the propeller sufficient excess material of alloy for error correction by machining.

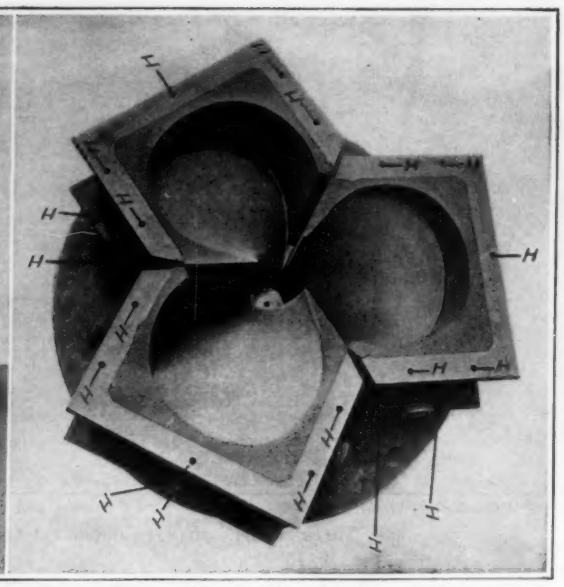
In exceptional cases a solid pattern is used. If it is of wood, it warps out of shape; and if of metal, it must be machine-finished, which is costly; and even in this case, castings will vary according to the individual dexterity of the workman, and with the

material and foundry conditions which are constantly fluctuating. The construction of a 15-foot diameter, 4-blade solid propeller by the sweep process requires from 15 to 20 days with the highest class of skilled molding, and the resulting propeller is more or less imperfect in the essential requirements. These defects must be made good in the machine shop where, because of the irregular formation of the propeller, it is almost impossible to produce a finished product that is in perfect agreement with the designed requirements.

By way of illustration of these facts we quote the following: four 3-bladed solid manganese bronze wheels were cast, the lightest weighing 14,392 pounds and the heaviest 15,807 pounds, the average being 14,747 pounds. The difference in weight was 1415 pounds, or nearly 10 per cent casting-weight variation. After machining, these four propellers averaged 12,082 pounds, the lightest being 11,800 pounds and the heaviest 12,223 pounds, a difference of 443 pounds. In this instance the weight variation was reduced from nearly 10 per cent in the rough casting to about 3¾ per cent after machining. Yet the heaviest rough casting became the lightest finished casting and the lightest rough casting became the heaviest finished casting.



4. Cope and drag, after baking, closed and secured accurately by machined surfaces and locating pins H



5. Three drag molds for three-blade propeller, assembled in their proper positions on the surface plate

The New Method of Propeller Casting

Now the method of casting known as the Thacher process which is herewith illustrated is one in which the causes of casting irregularity and error have been mechanically eliminated, and by the following means: In a propeller mold the hub and blade form is accurately located with relation to a perfectly machine-finished surface plate containing accurately established, drilled locating holes. Then the impression of these forms is mechanically transferred to sand molds contained within cast iron flasks having also accurately machined surfaces and identically similar locating holes. After the patterns are drawn the molds are sprayed with lead wash by air sprays to give a smooth finish to the surface of the mold.

The flasks molds are baked to present a hard surface that will not strain under casting pressure, and are then assembled on a large machine-finished surface plate, that contains a common center hole and a series of locating holes radially grouped around the center hole and corresponding identically with the locating holes in the flasks and pattern surfaces. These groups of locating holes are positioned at an angle of exactly 90 degrees for a 4-bladed propeller and 120 degrees for a 3-bladed propeller. Thus a pattern form established accurately with relation to a machined surface plate and locating holes, has been transferred mechanically to a mold form accurately established with relation to a machine-finished surface plate and identical locating holes; and as the blade as an entirety has been accurately transferred, every point in that form is positively established in correct position. The operation for each blade is identical, so it follows that the accuracy of each blade is identical. The work of preparing the surface plates, flasks, et cetera, is all within the range of standard machine shop practice, and is easily performed to an exact accuracy which will result in the foundry producing a propeller of equal accuracy.

TEST No. 1

Description	No.	Material	Size	Weight Lbs.	Average Lbs.	Pounds Variation
Blades	1	Cast Iron	17′ 6″	4875		1
Blades	2	Cast Iron	17′ 6″	4875		1
Blades	3	Cast Iron	17′ 6″	4875	4876	1
Blades	4	Cast Iron	17′ 6″	4880		4

Greatest Variation—5 pounds

TEST No. 3

Description	No.	Material	Size	Weight Lbs.	Average Lbs.	Pounds Variation
Blades	1	Bronze	18′ 6″	4345		2
Blades	2	Bronze	18′ 6″	4348	4347	1
Blades	3	Bronze	18′ 6″	4345		2
Blades	4	Bronze	18′ 6″	4350		3

Greatest Variation—5 pounds

The installations of this type of propeller have shown remarkable efficiency in operation.

Method	Rough Wt. Lbs.	Finished Wt. Lbs.	Molding Time Days	Per Cent of Actual to Designed Pitch
Old	*7703	6558	12½	Machined
Thacher	5308	4842	2½	99.9 as cast
Actual Saving	2395	1716	10	
Per Cent Saving	45.3	35.4	80.	

* Includes metal allowance for planing blades.

Table showing saving in time and material by the new process

Description of Equipment

A cast iron assembly plate, machine-finished over its surface, is provided with locating holes transferred from the jig or template, and on this plate the finished mold is assembled for pouring. A template of cast iron, carefully machined, is used in putting the locating holes in the drag pattern plate, the cope container, drags, copes and assembly plate. The drag pattern plate, on which is established a portion of the hub and the driving face of the propeller, is an accurately machined plate, with its holes drilled from the template. The cope container is a box-like structure of metal, with holes drilled from the same template. The drags and copes are also of cast iron and of box-like construction, heavily ribbed to prevent warping. The top and bottom surfaces are planed accurately and parallel, and it is drilled for locating holes to correspond with those in the assembly plate, drag plate and cope container. The drag pattern and cope pattern are made of hardwood or of metal, if preferred.

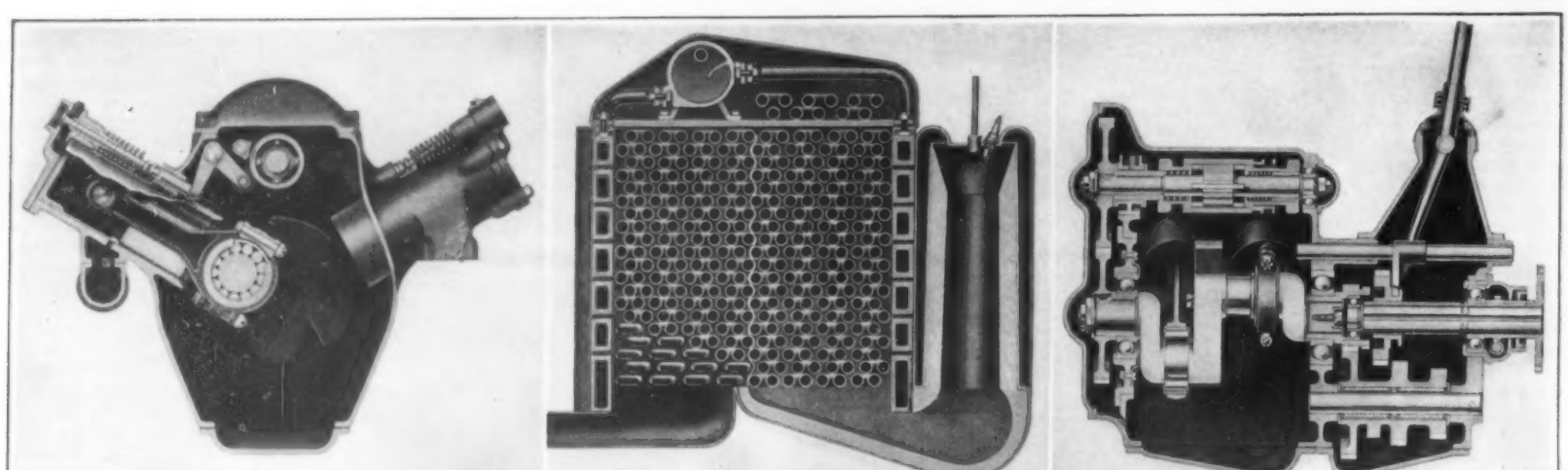
The Molding Operations

In the engraving, in Fig. 1, is shown the cast-iron drag pattern plate to which is attached a pattern of wood, which is set to the exact pitch of the driving face of the propeller. Over this is placed the drag or metal molding box (see Fig. 2), the two being fastened together through bolt holes H. Sand is then rammed up over the pattern which is now inside the

(Continued on page 292)

6. The three drag-and-cope units assembled on surface plate, with pouring ring above, ready for casting

7. Propellers made by this process are so accurate that no machining is needed. A burnisher gives the needed finish



End view of the motor — Firebox and boiler, side view — Side view of motor

Three sections showing important features of the new Coats steam car

A Steam Car That Is Different

Gas-Car Control and Gas-Car Finish with Steam-Car Smoothness

MORE than one steam car has been hailed as the new departure that would sound the knell of gasoline cars, but somehow or other many of these marvels have failed to materialize and nearly all of them have disappeared entirely from the markets they were supposed to capture. The principal reasons for this were that the faults of these early models were fundamental, and their complexity was such that drivers gave them little care and much abuse. The result was, of course, lack of confidence on the part of the driving public.

But despite the absence of steam automobiles, there has been great improvement in steam design and construction and the utilization of oils for fuel in the last fifteen years. Is the time ripe for a car embodying these improvements? The designers of the Coats car, illustrated herewith, feel that it is. This steamer presents an appearance so nearly the same as an up-to-date gasoline machine that it is practically impossible to tell the difference. Even upon close examination one might be unable to detect the fact that a gasoline engine was no part of its equipment. A foot brake and a "clutch" pedal occupy the usual positions and a gear lever exactly similar in appearance to those in use on gasoline cars is also placed as it might be on a gas car. The dash has a switch; there are electric headlights; the rear axle is practically the same as those in ordinary use; the "radiator," which happens to be a condenser, is nevertheless to all intents and purposes a radiator, and only under the hood is there a change.

But here the change is manifest. A boiler occupies a position just behind the "radiator" and immediately behind that, under the driver's feet, is the engine and gear box. Only in these units is the car different.

To start the car the driver does as he does in a gasoline machine. He turns a switch—starting a small electric motor which drives a fan and a pump. The fan forces air through the firebox, and when the pump has placed the fuel under 45 pounds pressure the automatic atomizing jet, at the top of the firebox, opens and sprays kerosene (which here gives better results than gasoline and is far cheaper) into this firebox in quantities exactly suited to the amount of air that enters. The kerosene is sprayed past a spark-plug which automatically ignites it, making the old and objectionable "pilot light" a thing of the past. The "fire" once started, enough steam to run on is generated almost at once.

A throttle lever placed just below the wheel controls the entire forward movement of the car. There are speeds—two of them forward and one reverse—but there is no clutch, and the car starts just as readily on "high" as on "low." Very little use will ever be found for low, except in emergency where excessive power is required.

To reverse it is necessary, as with the usual car, to shift gears, for this steamer is not equipped with a reversing engine. The reason for this is that most people are familiar with the usual gear-shift reverse, while few understand the principle whereby a simple shift of cams reverses the steam engine. Being without a clutch, however, makes it necessary for the driver to close the throttle before backing up.

There is a "clutch" pedal, however, but that is used only when more power or speed is needed. Then this pedal is depressed, allowing steam to enter the cylinders for the full length of the stroke. When the engine does not require this extra power the inlet cuts off the incoming steam when the stroke is five-eighths completed, and the expanding steam completes the stroke.

The engine is V-shaped and has three cylinders, with two on one side and one on the other. Had they been placed radially one cylinder at the bottom would have caused trouble by reducing clearance, and would have been a catch-all for water that might collect from condensation, endangering the cylinder itself, which might have been subjected to fracture because of the water being compressed by the piston. As the cylinders are placed there is no possibility of this, and the crankshaft is so swung that an impulse is given it every 120 degrees, while the impulses themselves are felt through very nearly 180 degrees, thus overlapping for nearly 60 degrees, and adding to the usual smoothness of the steam engine the overlapping power of the multi-cylindered gasoline engine.

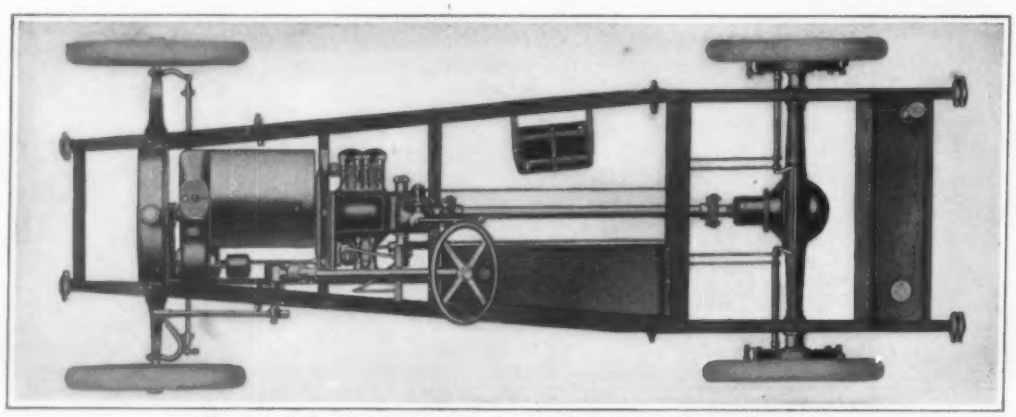
The engine itself is light, small and powerful. Tested as a gasoline engine would be tested, it produces over 50 horsepower, and yet it swings no flywheel and carries but twenty-odd moving parts. There are no spark-plugs in the cylinders, no carbon to foul the oil and hurry the wear of the cylinder walls and pistons. The pistons themselves are fitted with three rings each, which offers an exceptional factor of safety.

The inlet and exhaust valves are similar to those in use in most gasoline cars. The incoming steam enters when a poppet valve is actuated by a camshaft, and this inlet valve closes when the piston has moved five-eighths of the way down the cylinder, except when the foot pedal is depressed, when it allows steam to enter for the entire stroke. At the bottom of the stroke a port similar to those in use in some two-cycle engines is uncovered, and the steam escapes until that which remains in the cylinder is under ordinary atmospheric pressure. But instead of the piston's working against this pressure on its return stroke, a relief valve opens and the returning piston entirely exhausts the steam. At the top of the stroke the relief valve closes and the inlet opens, repeating the cycle.

The escaping steam passes into the radiator-like condenser, and when condensed returns to the water tank as water, retaining some of its heat and consequently subject to quick use again. The car carries 25 gallons of water and needs to be filled only after several hundred miles.

It is only natural that the boiler of a steam car should attract attention. The Coats boiler is unique in several of its features. It is built of 20 drawn-steel water-tubes, each 17½ feet long. These tubes are very easily interchangeable and can be removed and replaced merely by releasing two bolts at each end. The headers are built of pressed steel and are one-fourth of an inch thick. The hot gases pass down the firebox and are directed upward through the forward half of the boiler to the superheater above, and after passing the superheater and the steam chest, which are located on top of the boiler, they pass down on the other side of a baffle-plate that runs vertically and laterally between curves in the water pipes. The used gases pass through a long pipe the length of the car, and are finally lost in much the same way as is the exhaust of a gasoline car. In the whole car there is not a single appliance that is subject to adjustment. There is nothing that is not permanently set, and consequently there is no temptation on the part of the amateur driver to "monkey" with his car. For instance, the valve that sprays the fuel can by no possibility be changed. There is no adjustment to it. The safety valve on the boiler is set and sealed. It cannot be tampered with. The turn of a switch starts the car, and when the steam pressure reaches 600 pounds the fuel is automatically turned off, and when the pressure has been reduced to 550 pounds the fuel is automatically turned on and is ignited, not by a pilot light but by a spark-plug.

In cold weather the car stands no more danger of freezing than a gasoline car—less, in fact, for the heat stored in the boiler will for a considerable time preclude the possibility of freezing, and if the car is to be used in very cold weather, where it will be required to stand for long periods at low temperatures, anti-freeze mixtures can be used in the water without any danger, or the car can be drained with no more trouble than a gasoline car.

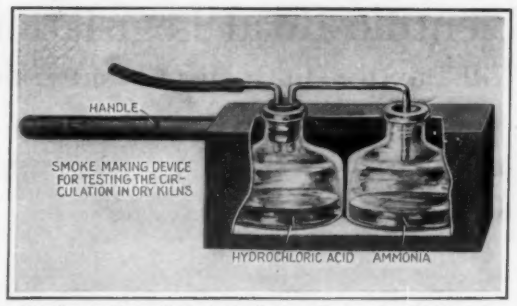


Chassis of the new steam car, showing location of the various units

Testing Circulation in Kilns

THE best method of testing the circulation in a dry kiln is to watch smoke travel through the piles of lumber. A device for producing a fireless chemical smoke is used for this testing by the Forest Products Laboratory. The device is easily made by using some short, thin boards; two small, wide-mouthed bottles; some three-sixteenths-inch rubber tubing; and a six-inch length of one-eighth-inch glass tubing. The chemicals used are concentrated ammonium hydroxide and hydrochloric acid.

In using the apparatus a small amount of each chemical is poured into the bottles. By blowing through the rubber tubing a dense white smoke issues from the bottle containing ammonia. The device may be carried into a kiln without danger of fire and the smoke will follow air currents without any tendency of its own to rise or fall.



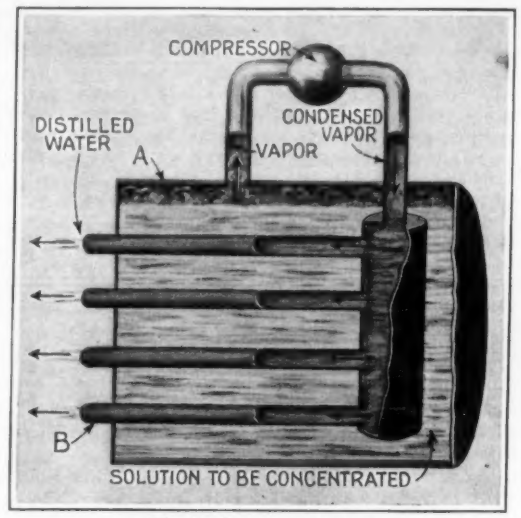
Smoke-maker that tells how air is circulating in drying apparatus and the like

Evaporing Apparatus That Dispenses with Fuel

IN a great many industries, such as the manufacture of salt, sugar, caustic soda and potash, an essential feature of the operation is the evaporation of the excess water from the solutions of the crystals. To evaporate 100 kilograms of water at 100 degrees Centigrade, 537 calories of heat must be furnished, which requires the burning of not less than 220 to 250 grams of good-quality coal. The heavy rise in the cost of coal during the last seven years has led to many attempts at the finding of a less costly method of evaporation. One of the most interesting of these is a revival of a process suggested by a French inventor named Pelletan, nearly a hundred years ago (1833). The principle upon which this method is based is shown in our drawing.

The solution to be concentrated is placed in a container, A, in which is immersed a coil of pipe, B. The vapor above A is drawn in by a compressor which recompresses it within B. Here it is condensed and thus restores its latent evaporation heat to the solution A. It is evident that the same heat required for the evaporation is used over and over for an indefinite number of times. The water discharged from B is pure distilled water, so that the process can be made to serve a double purpose—concentration and distillation.

It is obvious that the liquid which is condensed in B must have a higher temperature than that of the solution A, so that there may be an exchange of heat between B and A, but the difference between them need not be very great provided there is not much loss of heat; the degree of compression provided by the compressor must be calculated with this in view. It must also be taken into account that when a solution is concentrated the vapor tension of the solvent is lowered—in other words, when the same pressure is maintained at the surface of the solution the temperature of the latter will rise when the concentration is increased. Under these conditions the vapor or steam above the solution is superheated and the compression

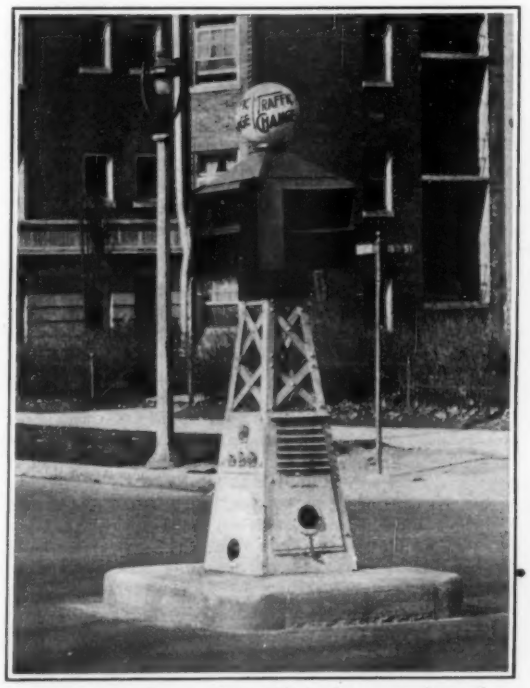


The fuelless evaporator

has hitherto been with the compressor, since both those which have an alternating movement and those known as ejectors, in which the vapor extracted from the solution is drawn in and compressed by a jet of live steam, are unsuited. The use of a rotary compressor appears to be more promising; in fact, important applications were made in Germany during the war, especially for the concentration of sea salt.

Aside from the economy of fuel the advocates of the Pelletan process claim another advantage—that of the facility with which it operates at a low pressure, and consequently at a low temperature, which, of course, makes it valuable for treating substances which undergo alteration at high temperatures.

The rotary compressor now in use, however, is not practically efficient at less than 50 to 100 horsepower. Hence it can operate only upon gases at a comparatively high pressure. For this reason the Pelletan evaporating process is limited at present on the one hand to large plants and on the other to evaporation not requiring a high degree of vacuum. Its application will undoubtedly be widely extended as soon as a rotary compressor having a high degree of speed and capable of extracting gases at low pressures is constructed. Even now it results in great saving of fuel where it can be suitably employed.



Automatic traffic regulator that gives warning when about to shift its indications

Automatic Traffic Regulation

AUTOMATIC traffic regulation is more and more the order of the day. Milwaukee is the latest city in the field with a device to effect this. The noteworthy feature of the installation, which we illustrate, is the excellent provision which it makes for changing the direction of traffic.

The four open windows which our photograph shows are duplicated on the other sides of the post. The upper compartments show the signal "Go" in green letters on the east and west, and "Stop" in red at north and south. The lower compartments reverse this arrangement. Reversal from the one set of signals to the other is done automatically, by means of a clock control. According to the relative importance of the streets at whose intersection the signal stands, the upper or the lower set of signals may be given more time than the opposing ones, by proper setting of the controls.

The appealing feature of this signal, however, is the "Traffic Change" globe that surmounts the whole. This is lit for a few seconds only, just before the shift in the signals. It gives warning of what is coming and affords an opportunity for all vehicles on the street that is about to be blockaded to clear the crossing. This globe is 16 inches in diameter, and when lit can be seen for a mile.

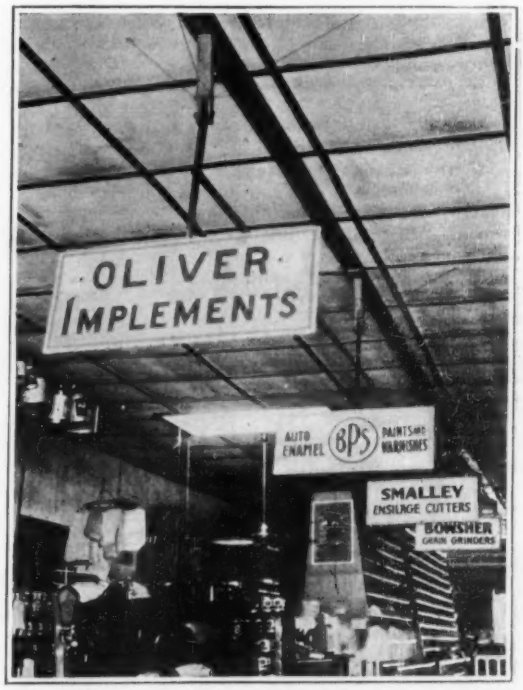
During the hours of darkness the four base lights are also lit, so that there can be no excuse for any driver's crashing the concrete base of the signal. The whole installation has made a decided hit with the Milwaukee public, pedestrians and motorists alike; and the use of the device will be extended. Since it was installed on August 12th at one of Milwaukee's test corners there has not been a single accident here. The signal is the invention of Hugo A. Kleinsteuber, of Milwaukee's police and fire-alarm system. It goes without saying that at times of parade, fire, extra heavy one-way traffic, etc., the motors can be thrown out of gear and the signal operated by hand.

Helium

THE experimental helium plant at Petrolia, Texas, conducted under the authority of the Army and Navy Helium Board, was in operation during the year at various times, and helium was produced for short periods. A study of the practicability of storing this rare and non-inflammable gas in mine workings was made at the Bureau of Mines' experimental coal mine at Bruceton, Pa. At the cryogenic or low-temperature laboratory in Washington, D. C., liquid air in quantity is now being produced. The primary object of this laboratory is to investigate gases and liquids at low temperatures, with special reference to the separation of helium from natural gas. Field investigations of possible supplies of helium in natural gas were completed during the year, every known gas field in the United States having been tested. Results were markedly successful, as they have shown that this country contains the largest supply of helium-bearing natural gas in the world.

A Cooling Fan That Advertises

AN Arizona shop that wishes to keep its patrons cool and at the same time justify the expense somewhat by advertising benefit ran two series of fans from the front to the rear of the store. Each fan surface is a muslin sign on a frame suspended from the ceiling. A jointed rod runs the entire length of each series with a pivot connection with each fan rod. The long rod is pivoted to one side of a drive wheel in the rear, so that as the wheel revolves it alternately pushes the fans forward and draws them back. The power is secured from the regular power shafts used by the concern; and being of a very low order, it costs little or nothing to produce.



These advertising signs are fans, too; they are rocked back and forth in their bearings by a shaft

Scientific Road Legislation

How the Federal Highways Act Will Take the Hit-Or-Miss Characteristic Out of America's Road System

By C. H. Claudy

THE United States has never until now possessed a truly national road policy. The automobile was developed, grew up and overran our two million miles of highways, with highway legislation lagging far behind its development. Sporadic attempts to arrive at a consistent scheme of a country-wide road system were made; cases in point being the Bureau of Public Roads with its experimental laboratories, and the recent Federal Aid Road Bills, encouraging the several states to build roads, by paying part of the cost from the national treasury. But not until the passage, in November, of the Federal Highway Act could we be said to have formulated a real road policy. This bill marks an epoch in our road construction, because, first, it outlines the beginnings of a national highways system, and second, because it establishes new principles in the legal aspect of governmental road construction.

Hitherto Federal aid has been distributed among the states according to a formula taking into consideration existing road mileage, population and amount of rural free delivery routes. Beyond this the Federal government did not go; states were permitted to spend their Federal aid upon any roads in the state they desired which might meet with the approval of the Secretary of Agriculture.

Now all Federal aid must be spent upon not exceeding 7 per cent of such state road mileage, and three-sevenths of this mileage must be "primary" or "interstate" highways. Moreover, the designation of these interstate highways is left not entirely to the State Road Commission. The road plan of this Commission for highways to receive Federal aid is subject to review and approval by the Secretary of Agriculture (which means, in effect, the Bureau of Public Roads), so that the "interstate" highways of adjoining states may be made to join. In other words, Uncle Sam is going to give Federal aid to states, as before, but now is going to be sure that three-sevenths of the roads so aided shall form a national highways system. The remaining four-sevenths of a state's road mileage, which may receive Federal aid, must "connect or correlate" with the three-sevenths.

This is the real beginning of national highways. The power of initiation of a Federal-aided road-building program is still with the state, but the power of veto is with the Secretary of Agriculture, and neither state nor Secretary may permit less than three-sevenths of the designated mileage to receive Federal aid.

The most vitally important provision of the Federal Highway Act is that for maintenance. Curiously enough, we, who pride ourselves upon being the most practical people in the world, especially in matters of engineering, have never fully recognized the undoubted fact that roads wear out just as do any other man-made product. Our roads have been built, often, as well as roads can be built. Our engineers need take a seat back of no corps in the world when it comes to layout, drainage, curves, grades, materials, foundations, subsoil, packing, construction, and finish. But we have too often gone upon the hypothesis that a road, once built, was like a monument, enduring for all time. Hence an intolerable waste of public money has resulted, in the often complete destruction of fine roads, due to parsimony in maintenance funds or the complete absence of any systematic maintenance plan.

Nothing like that under the new Federal Highway Act. States accepting Federal aid to build roads must maintain the roads so built, and provide in advance the necessary funds. If they do not, the Secretary of Agriculture will notify them. If, after notice, they still do not maintain their Federal aid roads, the United States will come into such states and do it for the state, and thereafter those states get no more public funds for road improvement until those maintenance bills are paid in full.

As the time to begin to maintain a road is the day when it is opened for traffic, no state can accept any Federal aid for any road building without showing the funds in hand for maintenance.

Here is the second legal moving spring toward national highways, as completely made, owned, improved and maintained by the nation. In course of time, as a larger and larger mileage in each state gets improved and demands maintenance, a larger and larger proportion of state funds will be so utilized. The "saturation point" will come sometime, when all the state's road funds are absorbed in maintenance. At that time, when a state finds itself estopped from further participation in Federal aid because all its available funds are used in maintaining already built Federal-aid roads, it is likely to become an enthusiastic convert to the doctrine that the Federal government should maintain all interstate roads. And when the United States undertakes a policy of road maintenance, it is obvious that it will also undertake a policy of national road-building.

Upon these two great provisions of the new act "hang all the law and the profits" (to paraphrase) of road building in its new legal aspects.

There is no loophole left for political graft within the state. In times gone by jobs upon the State Road Commission were not infrequently looked upon as proper rewards for party work, without any regard to the engineering fitness of the appointee to the work to be done. That is now impossible. The act specifies only such "durable types" of surface and materials as will "adequately meet both the existing and probable future traffic needs" and also lays down the dictum that the word "maintenance" means "the constant making of needed repairs to preserve a smooth-surface highway."

From time to time there have been examples of well-conducted propaganda campaigns in this country looking toward the adoption by the United States of some "standard type" of road. Naturally the people who make brick would like to see brick made the standard. The concrete people would find much profit could Uncle Sam be led to demand concrete for all road construction, and the tar-and-oil-product people would like to see macadam roads treated with their products made a standard.

Their hopes are finally and forever dashed in this bill, which is as it should be. In a country of such variety as this, where both the road-need and the road material vary largely, the specification of any one type as a standard would be a "pork barrel" of unprecedented proportions. Hence the provision of this act is of great importance that the Secretary of Agriculture "shall approve the type and width of construction and reconstruction and the character of improvement, repair and maintenance in each case, consideration being given to the type and character which shall best be suited for each locality and to the probable character and extent of future traffic."

Unfortunately, our legislators either lack vision or have too much confidence in the ability of any one man, no matter how honest, to dare criticism. For while the act specifies a wearing surface of not less than 18 feet (save in some special cases) the important matter of "right of way" is dismissed with the single proviso that it be of "ample width." What, O Solons, is "ample width?"

Broadway and Fifth Avenue were both of "ample width" when laid out. Are they now? At what cost could Broadway be widened? Had Broadway been widened a hundred years ago it would have cost, perhaps, less than would now be needed to widen one block of its length.

The country road of today is the intercity boulevard of tomorrow. Twenty years ago an 18-foot road between New York and Philadelphia was plenty big enough. Is it so today?

"Ample width" means anything, or nothing. Doubtless a man building an 18-foot road today thinks 30 or 40 feet of right of way "ample." But what of tomorrow, a hundred, two hundred, three hundred years hence? Will a hundred, two hundred, even three hundred feet be then of "ample width?" Does it take a Jules Verne to imagine a 300-foot boulevard between great cities, its center devoted to high-speed traffic, its adjoining sections to normal-speed traffic, its edges to truck traffic? Why wait until property is prohibitive in price to secure a real "ample width?"

However, no law is ever perfect, and this one doesn't pretend to be. It is a great step in advance. It turns over to road making an enormous amount of surplus War Department machinery — tractors and road machines, steam shovels and concrete mixers, etc. And this is of vital importance; for states too poor, or too backward, or too ignorant to appreciate what modern machinery can do, and which therefore will not purchase, will take as a gift and use the "new-fangled" road making methods. And once the object lesson has been seen, exit the old way of making roads, by shovel-in-hand and inexpert labor.

The new law is specific on many other points. One of special interest to travelers is the provision that all Federal-aid highways shall be toll-free, and that "bridges" are considered as included in the term "highway." So there must be an end to toll bridges if they are on Federal-aid highways. But it would be impossible in an article of this length to analyze the bill in its every section. Suffice it that this is constructive legislation, that it specifies an interstate system and demands maintenance, so that the hundred and fifty millions of dollars which may be spent by states and nation together in the next eight months will go for something which really connects part with part, and for roads which, once built, can not thereafter be neglected, to the detriment of traffic and the wasting of their cost.

ONE of the natural consequences of national growth and national development is that some things that were once regarded as matters of purely local concern, in which the Federal Government should under no circumstances meddle, are now found to be of more than local consequence. A hundred years ago it was not mere local pride and prejudice that made road-making a local affair: it was the very nature of the case that made it so. Today, by the same token, it is not Federal interference or the desire of one section of the country to run things for another section that leads the Government at Washington to take a deep interest in roads throughout the nation and to formulate a program for their proper construction and maintenance: it is the fact that, in 1921, roads are a matter of national concern that lead to this action. What the Federal Government is to do for America's roads, and why, and what should grow from it, under the Federal Highways Act which was passed in November, and is just coming into good effect as this issue reaches our readers—this is Mr. Claudy's theme here.— THE EDITOR.

Why Not Stainless Steel Cutlery?

AN American lately returned from abroad, having visited South America, Australia, South Africa and Great Britain, was impressed with the stain-resisting steel which is now very rapidly replacing the usual form of steel cutlery knife. He made inquiries, on coming home, whether it was possible to purchase similar knives here; and he found that the knives available were indifferently finished and it was difficult to get any of this new steel.

On further pressing for information he found that the best of this stain-resisting steel is the result of an invention on American soil. He made it his business to call on one of the large cutlery manufacturers to find out first-hand why it was not possible for him readily to buy never-staining cutlery. Stripped of much verbiage and extraneous matter, the explanation offered was that the American consumer had already substituted the familiar plated knife, with its utter inability to cut anything tougher than hot butter, for the old-fashioned stain-inviting steel knife; and that the American housewife had not become educated to the advantages of the stainless steel and to its beauty.

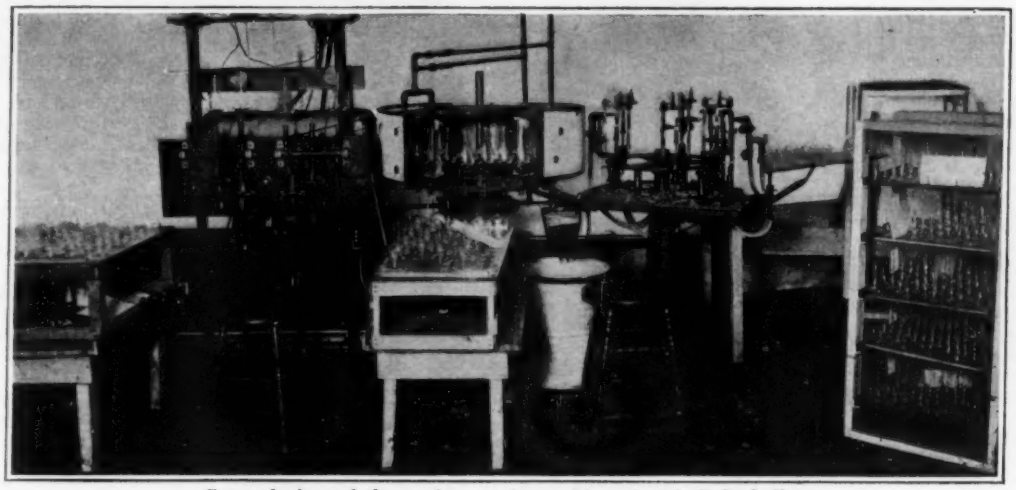
Under cross-examination, however, this manufacturer was asked how long the average stainless-steel knife-blade ought to last with the amount of sharpening it is likely to get in ordinary use. Reluctantly and indefinitely he put the period at about twenty years. In response to the definite question, he then freely admitted that within a very short time his plant alone could turn out all the knives that the American public were likely to buy providing there were no replacements in a period of, say, twenty years. It appears, therefore, that the only way the American consuming public will get stainless steel knives is by insisting upon having them. As for their advantages, even the maker of the other kinds of knives will hardly enter much rebuttal, unless it be on the ground of cost.

The Raw Materials for Artificial Daylight

Some of the Little-Known Processes and Machines Used in Making Incandescent Lamps

By Harry A. Mount

A BRIEF investigation on the part of the writer served to establish the fact that a visit to one of the great incandescent lamp factories near New York, for the purpose of describing to readers of this journal the intricate process of manufacture—or for any other purpose—would be impossible. Aside from the German dye industry, there is perhaps no other which guards its secrets so closely as does the incandescent lamp industry. Notwithstanding that the electric light is one of the outstanding developments of an age of mechanical and electrical marvels, few persons know anything of the methods of manufacture.



General view of the equipment for making electric-light bulbs

An official of one of the great factories of the kind explained that while the largest plants operate under license from a parent concern, which maintains great central research laboratories, each of the individual plants maintains a research staff of its own, engaged especially in the design of automatic machinery for lamp manufacture. Thus, the research development on incandescent lamps is available to all of these associated manufacturers, but the machinery is not common property, and each factory has secrets which it guards even from its associates. And especially are these secrets guarded from the ears and eyes of some fifteen independent manufacturers who operate without license. But through the courtesy of Mr. Charles Eisler, of Newark, N. J., one of the foremost designers of lamp-making machinery, we are at last enabled to present herewith what is believed to be the first popular exposition of modern electric lamp making.

It is probably because the public has not been allowed to watch the evolution of lamp making from the days of tedious hand work, that the machinery which makes modern lamps seems little short of marvelous. The machines seem the more wonderful to the eye of the layman because many of them handle glass, and the idea of modeling glass parts with minute precision by automatic machinery is in itself something of a novelty. The usually well-informed man would probably say that incandescent lamps were made by skilled hand workers, trained to the tedious processes involved. As a matter of fact, they are touched by human hands only in being transferred from machine to machine. Marvelously contrived machinery now does the work that once was done by skilled fingers.

Have you ever examined an electric light bulb from the viewpoint of a manufacturer? It presents a puzzling manufacturing problem. In making an ordinary vacuum-type lamp—the easiest of all—there are no less than seventeen distinct manufacturing operations. The gas-filled lamps require a number of additional processes.

The first step is the drawing of the tungsten wire for the filament, and in all industry there is not a more delicate manufacturing process. The tungsten comes to the plant in the form of a powder, and by means of great hydraulic presses exerting tremendous pressure, this powder is molded into slugs ⅜ of an inch square and from 12 to 16 inches long.

The slug must be most carefully handled in removing it from the press and placing it in a "sintering furnace" where the two ends are connected to a powerful electric circuit. Current is passed through the tungsten slug until it is heated to incandescence. This causes a welding together of the particles which compose the slug, after which it is not so liable to break. The metal is still too brittle, however, to be drawn into wire in the ordinary manner, and swaging is resorted to. The swaging machine contains a multiplicity of small hammers which operate very rapidly and beat the slug down to a smaller diameter. By a number of swaging operations the slug is finally reduced to a wire about 1/32 of an inch in diameter. Drawing is then begun. The wire is drawn through a succession of diamond dies, each die reducing the diameter of the wire about 10 per cent. The dies consist of steel blocks in which a diamond is set. A hole is drilled through the diamond, through which the wire is drawn mechanically. When finally the wire is drawn to the fineness of a hair, its original length of sixteen inches has increased to thousands of feet. The last stages of the drawing must be done in very fine steps, for the wire must be perfectly drawn and of a uniform diameter to insure a uniform quality of filament. If the wire is to be used in the ordinary vacuum type of lamp it is then taken to a zig-zag machine which heats the wire electrically, bends it in the zig-zag shape it must have in the lamp, and winds it in this shape on spools. The crucial step in this operation—the bending—takes place in a nitrogen-filled chamber while the wire is hot.

The next step is to make the stem which supports the filament in the lamp. This consists of a "flare tube" or base through which lead-in wires pass to carry the current to the filament, and a "cane" or solid glass stem with "buttons" at top and bottom to hold the wire hooks that finally support the filament.

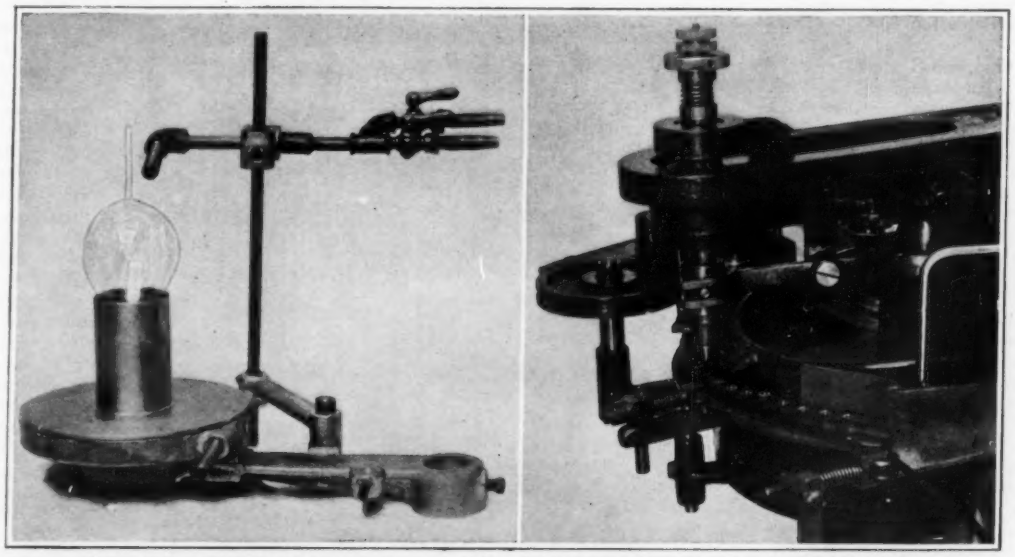
The stock for the "flare tubes" comes from the glass manufacturer as straight glass tubes about three feet long. These have to be cut into short lengths. The cutting is done by a girl operator who holds a handful against the inverted V shape edge of a carborundum wheel running at 3500 revolutions per minute. This quickly snaps off the glass to the right length and a skilled operator with this simple machine is able to cut from 4000 to 5000 flare tubes per hour. The wheel of the machine is enclosed, and the housing is so designed that a centrifugal exhaust action takes place, sucking the glass dust away from the operator. The cut lengths fall into a hopper, from which they pass to the hopper of the "automatic flare machine."

This machine makes a funnel shaped flare at one end of the tube. The tubes are fed from the hopper into indentions in the circumference of a large wheel which carries them under the flames of gas blowtorches. When the glass is at the right temperature a blunt reamer is projected into the end of the tube, shaping it. The piece then is discharged into another hopper. These machines finish parts for standard vacuum lamps at the rate of about 1500 per hour and require so little attention that one operator can attend to three of them.

The "cane" or glass stem is made by a process differing only in that at the point where the flare is made, the automatic machine makes two bulges or "buttons" on the stem. Next the leading-in wires are made. These, although apparently of minor importance, are really one of the deep problems of lamp manufacture. Since they comprise the only points at which air might leak into the bulb, it is extremely important that the coefficient of expansion of the metal and the glass be the same. This is not always possible, however, because of slight variations either in alloying the metal or in compounding the glass. The old method of preventing leakage was to weld two tiny globules of metal on the wire at the point where it passed through the glass. This has been discarded, however, in favor of a wire that is simply crimped at this point. Leading-in wires of this type are produced by an automatic machine at the rate of 100 a minute.

With the flare tube, stem, and two leading-in wires complete, the next step is to weld these into a single unit. This also is done by an automatic machine. On this machine the operator simply places the four pieces in position in a specially constructed head and unloads the completed piece. The machine automatically moves the pieces from one position to another, first heating the glass and then clamping the pieces to seal them. Finally the machine re-anneals the glass to remove strains which might cause cracking.

From this point the part goes to an automatic inserting machine which at one operation makes the little wire hooks which are to support the filament, heats the "buttons" and inserts the straight ends of the hooks. The final step in completing the stem is the only operation in the making of the lamp which is still a hand process—that of mounting or "draping" the filament in position. A girl operator takes one end of the zig-zag



Left: Sealing off the lamp, thus forming tip. *Right:* Automatic machine for making the glass flare tubes

Two of the very special pieces of apparatus used in the manufacture of the latest electric lamps

filament, places it on the end of one lead-in wire and then by means of a small electrical hot-clamp or spot-welder, welds the two together. She then rapidly drapes the filament over the hooks and welds the other end of the filament to the other lead-in wire. The "stem" is then complete.

The glass bulb itself usually comes from the glass maker already blown to shape, excepting that the familiar sharp tip is missing and the base end is large enough to admit the finished stem. The first step in preparing the bulb is to puncture a small hole at the rounded end of the bulb and weld on at this point a short length of glass tubing. This tube is for the purpose, later, of extracting the air from the bulb.

The bulb and stem are now ready for final assembly, and this is done on a "sealing-in" machine which automatically welds the "flare" to the base of the globe, at the same time reducing the diameter of the globe base and finally shaping the globe. The filament, before being sealed in the globe, has been given a chemical coating, the purpose of which will be explained presently.

Polishing the finished lamps

After sealing, the bulb is placed in an automatic exhausting machine, being held in an inverted position with the tip tube inserted into a rubber bushing. A valve is opened which applies a "rough exhaust" to the lamp. This valve is quickly closed and another opened which effects a final exhaust at a slower rate. The mercury vacuum pump which was formerly used for this purpose has been abandoned for new types of mechanical vacuum pumps. When the vacuum is complete the final sealing of the bulb is accomplished by melting the tube off to the form of a sharp tip.

After exhausting, the lamp is placed in an automatic "flash aging machine" where current is first applied to the filament, being gradually increased until about a 10 per cent overload is applied. This burns off the chemical coating on the filament and destroys any oxygen which may not have been exhausted.

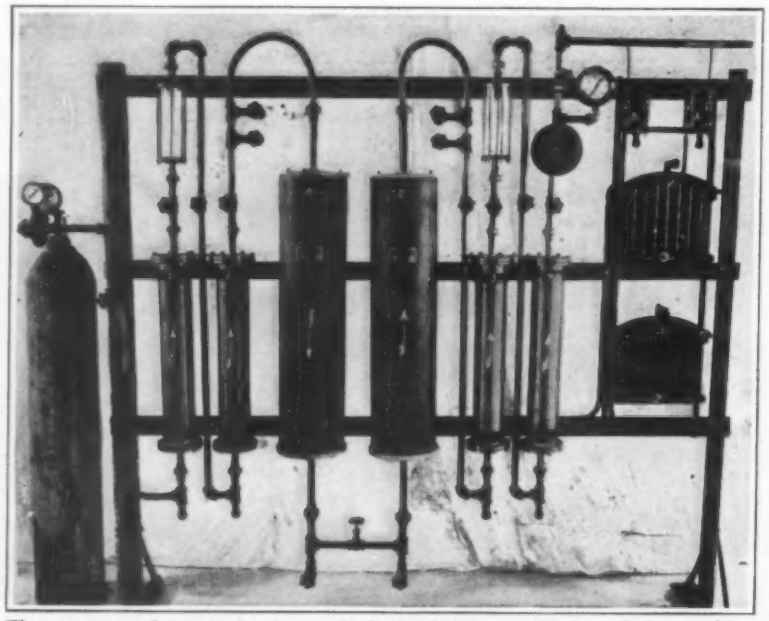
The final step is to fill the brass base-plugs with a mixture of shellac and cement, apply this to the bulb, and solder on the lead-in wires. All of this is done by machinery. Then comes final inspection, labeling, and packing in cartons.

As intricate as this process may seem, it is quite simple when compared with the manufacture of the newer gas-filled lamps. Although the same general lines of procedure are followed, there are complications from the very beginning.

In the first place the filament must be made into the form of a coil of exact specifications. Ordinary coiling methods were found slow and uncertain for this work and so a new machine had to be devised for the purpose. The latest coiling machines are capable of running continuously from two to four hours without attention, coiling a filament from four to six thousand feet in length, depending on the size of the wire. A coil as fine as a hair, with the individual wires hardly visible to the naked eye, can be wound as easily as the largest motion-picture-lamp filaments. In the smaller coils as little as 2/1000 inch is allowed for the hole through the center of the coil.

This delicate operation is accomplished by first winding the filament wire on a bobbin, which is revolved rapidly about a steel core-wire, the core moving forward at the proper rate of speed. The movement of the core wire is regulated by a friction-driven drum, and in making intermittent coils a cam movement causes the drum to "jump" at intervals, producing a jump in the winding. The tungsten wire is very brittle, and winding at such high speeds would be impossible without heating the wire. This is done electrically, the section between the bobbin and the core being kept at a red heat.

The continuous filament, with the steel core still inside it, is then taken to an automatic machine which cuts it to the right lengths. In some cases, then, the steel core is pulled out by hand, but usually thousands of them at a time are dropped into an acid solution which dissolves the core, leaving the filament. After removal from the acid the coils are boiled in a sodium hydroxide solution for five or six minutes, washed in dilute hydrochloric acid for about 20 minutes, and finally washed in running water to make sure the coils are free from acid. After drying on a hot plate, the coils are baked in a hydrogen atmosphere (to prevent oxidation) at from 950 to 1050 degrees Centigrade for eight or ten minutes. This is done by placing the coils in an electric circuit and holding them inside an inverted nickel cup, containing hydrogen, or by baking in a small electric furnace. Some types of coils are shaped at the same time by hanging weights at proper intervals during the baking or "flashing" operation. As a final step the coils are inspected. A projecting lantern with a microscopic lens is used. The coils are placed on a glass plate and their image projected to a screen, with a magnification of many thousand times. The inspector is able easily and rapidly to pick out defective coils by this method.



The compressed-gas tanks from which the bulbs are filled, and the washing machines that purify the gas before it goes into them

Other operations on the gas-filled lamp differ only in detail from the vacuum lamp until the operation of sealing the tips is reached. Here the lamp is exhausted in the usual manner and then nitrogen gas is admitted and the sealing is completed.

Greater speed and perfection in manufacture are attained ofttimes by combining in a single operation two or more of the processes described heretofore. For instance, the sealing-in and exhausting is combined in the latest installations. The sealing-in operator places the sealed lamp in a rotary oven which at once prevents the glass from cracking after application of the blow-torch, prevents moisture from gathering inside the globe, expels about half the air by heating it, and finally carries the bulb to the exhausting operator. Since the exhausting machine works at about the same speed as the sealing-in machine the two operators keep pace with each other and are able to complete from 200 to 225 lamps per working hour.

The making of miniature electric lights, such as are used for automobile headlights and pocket flashlights, presents a particularly difficult manufacturing problem. The ordinary machinery for standard lamp making is used as far as possible, but more hand work is required on this type of lamp than any other.

The accuracy of the manufacturing methods is tested in any case by taking an occasional lamp from the regular production and testing it for candlepower and for the whiteness of its light by means of a spectroscope. Both tests are combined in a single machine called the "spherical photometer," which is provided with a system of curved mirrors and lenses, a screen and a series of disks which indicate to the expert operator the qualities of the lamp.

The tendency in lamp manufacture is toward even greater application of automatic machinery. Indeed, it requires no great stretch of imagination to give credence to the statement that the day is not far distant when electric lamps will be made without the touch of a human hand.

While one great centralized group of scientists works to the end that the lamp itself shall be a more efficient servant, other groups are keeping pace in manufacturing by designing machinery that will turn out the lamps cheaper and of more uniform quality. The very fact, however, that lamp-making machinery is of such an intricate and highly specialized nature forbids frequent changes in lamp design. A complete change of lamp model would involve the scrapping of many thousands of dollars' worth of machinery in a large lamp factory. It therefore happens that while small improvements are being constantly made in lamp design, radical changes occur only at rare intervals when laboratory development has proceeded so far ahead that a change is imperative.

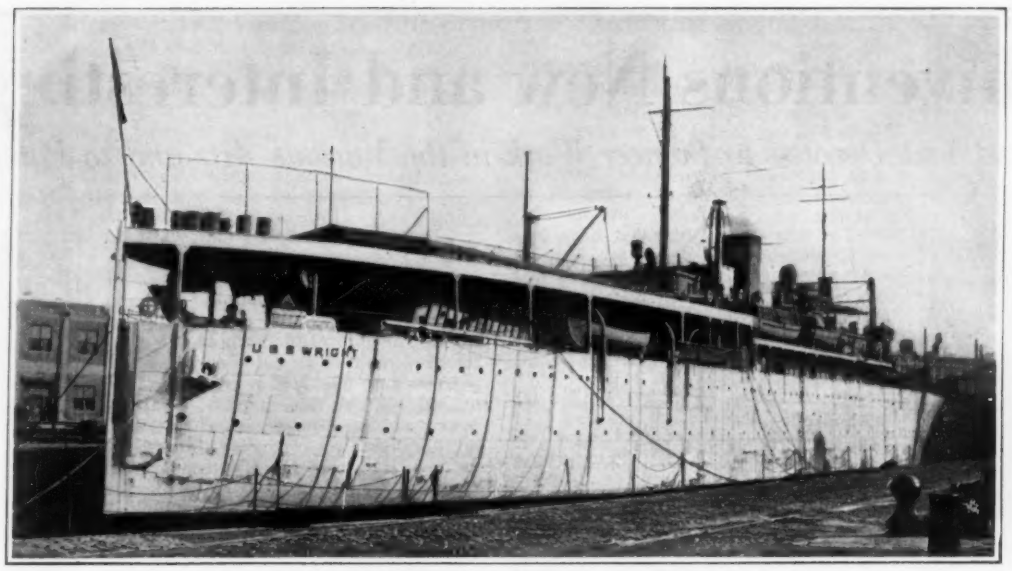
As a matter of fact, scientists in the great lamp laboratories could probably show us today, if permitted to do so, electric lamps which burn only a fraction of the electricity consumed by the appliances now in common use, and which outlast present-day lamps many times in service. As soon as the balance of economies permits, and after most rigid tests prove beyond a doubt the ultimate value of such inventions, then we shall have them in our homes.

The Effect of Internal Secretions: Why We Are What We Are

THE relation of the glands of internal secretion, commonly known as endocrine glands, to human development and human behavior is becoming daily more obvious. Stature, build, proportions; details of development of bone, teeth, nails, hair, skin; intelligence, emotional control: all these things can be shown to be influenced by endocrine secretions. Indeed, it seems naturally to follow that the hereditary differences between people are due to hereditary differences in the activity of these glands. These glands, as is well known, secrete substances called "hormones" which regulate our physical, mental and temperamental constitution. The special quality and quantity of these hormones is determined by the idiosyncrasies of the enzymes of the germ cells. The hormones that determine our personality constitute the bridge that connects this personality with the specific enzymes packed away in the chromosomes of the germ cells. You and I differ by virtue of the difference of atomic structure and atomic activity of the enzymes and hormones which make up that part of the stream of life-yeast which has got into and is activating our protoplasm and will activate that of the fertilized egg that results from us and our consorts. Thus each is what he is in his physique, in his thoughts and in his reactions largely by virtue of the peculiar properties of those extraordinary activating substances, which are specific for him and other members of his family and race or biotype. The future of human genetics lies largely in a study of these activities, and the origin of differences or mutations in them.—*Abstract from an address by Dr. C. B. Davenport before the International Congress of Eugenics, New York, October, 1921.*

U.S.S. "Wright" — Our First Balloon-and-Airplane Carrier

THE United States' first balloon and airplane carrier is nearing completion at the Brooklyn Navy Yard This vessel has been remodeled from the U.S.S. "Wright,' designed originally as a transport. She was very fittingly named in tribute to the late Wilbur Wright, who, cooperating with his brother Orville, was the first to fly in a heavier-than-air machine, and from whose genius the development of aviation derived so much of its impetus.

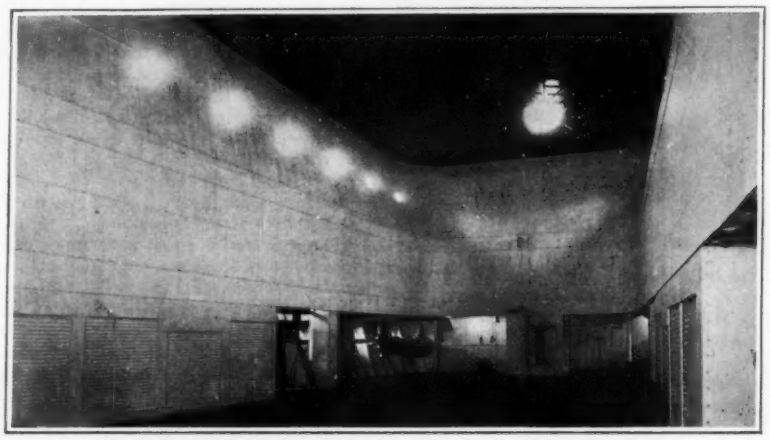


Quartering view of the U.S.S. "Wright," showing the exterior of the well in which the balloon is housed

Our first aircraft mother ship

The "Wright" is one of the ships built at Hog Island for war service. In her new capacity her chief usefulness will be in handling balloons and as a tender for seaplanes at sea, and in this respect she will be unique among fighting craft, so far as the U. S. Navy at least is concerned. To put the "Wright" into condition an amount of reconstruction proved necessary which did not fall far short of the building of a new interior. Except for the engine and boiler room, the whole interior of the ship has been altered and fitted out to meet the new demands made upon her.

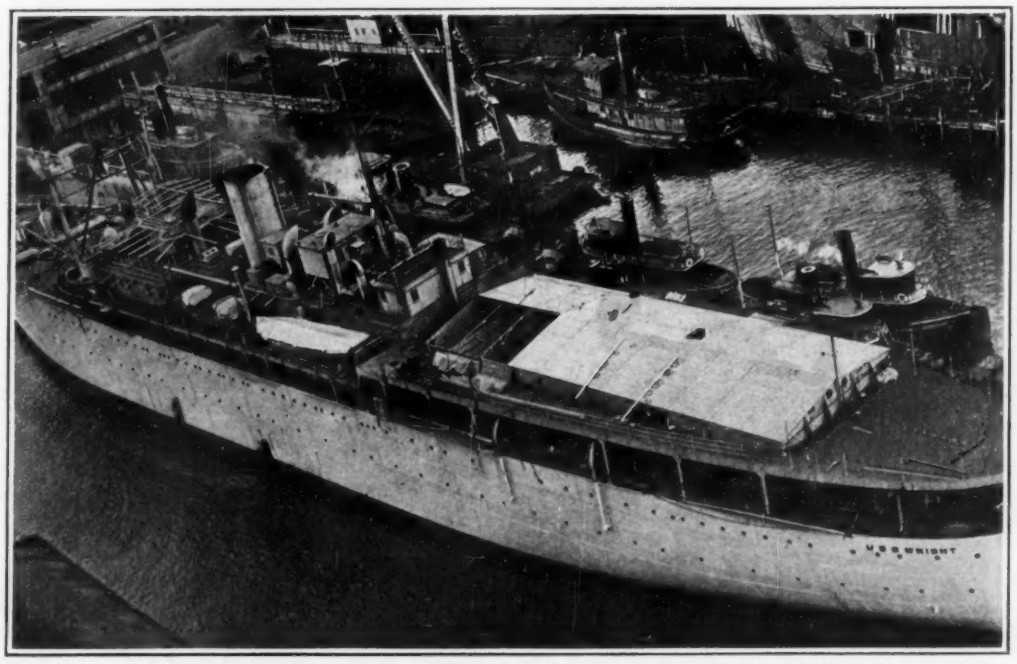
In the after end of the vessel is something quite new on ship board; a balloon well 100 feet long, 40 feet wide and 30 feet deep. Farther aft is a stowage space for another, smaller ballon, and also a plant in which hydrogen gas to inflate the balloons will be generated. The balloon wells are protected from the weather by sectional hatches, which can be shifted into position by a trolley which runs from the deckhouse to the stern. At the forward end of the ship a large machine shop has been installed, fitted with everything necessary for the repair of the planes and balloons. There is a generating plant; also tanks for hydrogen, and stowage space for spare wings and parts. An ærological laboratory has also been provided, as well as a fully equipped photographic laboratory. Electric motors will operate much of the machinery and other equipment of the ship.



Interior view of balloon storage well of the "Wright"

The actual fighting equipment of the "Wright" will consist of only four 5", 51-caliber guns, two forward and two aft, also two machine guns. It has been decided that naval armament of any consequence on an airplane carrier is really quite unnecessary because, as Admiral Sims has shown, these boats will never be called upon to take an active part in any conflict, their fighting seaplanes affording all the protection they need. When an enemy fleet is at least 100 miles distant, the airplane carrier will receive word of its approach, and she need not steam into close proximity to the hostile fleet. She will remain out of range of its guns and dispatch a squadron of her planes to meet the enemy. Circling over the fleet, these planes will proceed to battle by dropping their bombs on the hostile ships.

In a recent experiment, the old U.S.S. "Indiana," while anchored, was made a target for bombs from airplanes. The fall of every bomb was carefully plotted on a map. In that experiment, 55 bombs fell upon the ship's deck, and 50 more fell within the danger zone. Some of the planes swooped down and spiraled around the vessels, until they were only about fifty feet above the water, and then they let fall their torpedoes. To the landsmen it would appear an easy matter for the ship to attack an airplane flying a few hundred feet above the water. But the gunners on the battleship have no means of calculating the distance of the airplane, and would have to shoot at sight, with the planes traveling perhaps 150 miles an hour. They would be in the position of a man shooting at wild ducks or partridges.



Note the removable roof of the balloon well, with sections removed showing interior

View looking down upon the U.S.S. "Wright"

The chances of the gunners scoring a disabling hit under these conditions are rather remote. At the greater heights of 7000 to 10,000 feet, the hits might be only one in a thousand, this being the exact proportion of hits scored by anti-aircraft guns during the war.

Statistics compiled officially in a recent tabulation of the relative merits of warships and air crafts showed substantially the following results:

(a) As regards first cost, a modern armored warship, with the accessories, costs more than $45,000,000; one bombardment airplane, capable of carrying from three to five bombs, costs $45,000; wherefore, 1000 bombardment airplanes can be constructed for the cost of one battleship.

(b) The recent war has demonstrated that projectiles are efficient in accordance with the amount of explosive carried. The projectile from a heavy gun carries from fifty to sixty pounds of explosive; the one-ton bomb carries from one thousand to fourteen hundred pounds of explosive. An air projectile, therefore, carries more than twenty times the amount of explosive carried by a cannon projectile.

(c) An airplane travels from 100 to 200 miles an hour; a warship travels from 20 to 50 miles an hour—the speed being four to five times greater for an airplane than for a warship.

Many naval officers believe that the most effective warship of the future will be a mother ship or airplane carrier such as the "Wright," but, of course, larger and faster. Such a ship will have a speed of from 30 to 35 miles an hour. Instead of being crowded with guns she will be devoted to the storage and launching of seaplanes and balloons.

In England, men of the royal air force, ever since they returned from the war, have not hesitated to tell men afloat that they would not, in the next war, give a straw for all of Great Britain's boasted superdreadnoughts and cruisers that she may build between now and then. The advocates of the fleet have just as warmly insisted that they could take care of themselves no matter what the flyers essayed. The controversy finally led, not long since, to a request that the Admiralty detail a squadron of representative ships for an offshore mimic combat with a force of bombing machines.

This was agreed to, and when the time arrived the airplanes mounted high into the sky, where they could not be seen, and where the hum of their motors would not betray them. There, far beyond the reach of the guns of the so-called foe, they dropped smoke-making missiles on the sea, and in an astonishingly short while they created a barrage that closed about the vessels, causing much uncertainty.

While the ships were still guessing and contending with the smoke screen, the bombers swooped down on the hampered craft and launched dummy projectiles, simulating bombs. When the whirlwind assault had ceased seven of the squadron were declared hors de combat, or sunk by airplanes. None of the machines was theoretically sacrificed.

But, though the experiment is strongly suggestive it is not absolutely conclusive.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

The shockless—speaking relatively—motorcycle seat

A Shock-Absorbing Saddle

MOTORCYCLE seat suspension is ordinarily a rather simple business, not materially different from that of the old-fashioned "bike" save in its provision of stronger springs to take the heavier rebounds caused by the higher speeds. What appears to be a rather carefully thought out effort to improve the riding qualities of the little brother of the automobile is illustrated herewith. The usual compression springs are seen immediately beneath the saddle, between it and the rear frame-tube. In addition to these, however, there is supplied an elaborate series of springs joining the saddle to the upright tube of the frame. It will be noted that the short pillar-tube that carries the saddle immediately is swung on the frame-pillar entirely through these springs, with the double rocking-lever that accompanies them. These suspension springs at the fore of the saddle play against one another and against the rear compression springs in such a way that abrupt rebounds are checked more effectually than is the case in the ordinary design.

Huge Roller Bearings Carry Big Doors

THE hangar doors in the dirigible shed at Lakehurst, New Jersey, are carried by remarkably large roller-bearing journal boxes. The doors are of structural steel, and two doors are located at each end of the building. Each door weighs 3500 tons and is 135 feet in height and 165 feet wide. Measuring 15 feet through at the base, the doors are weighted at this point with concrete and steel to offset wind pressure. Unlike most sliding doors suspended from tops of buildings, these doors are entirely independent of the hangar building and run on four eight-wheel trucks operating on two standard gage railroad tracks. Each track is operated by an electric motor and a hand windlass is supplied for emergency use.

Thirty-two journal boxes are required for each door, and the weight of each bearing with the cast steel housing is 392 pounds. The load capacity of each bearing is 150 tons at one revolution per minute. Without the housing the bore of the bearing is 7 inches, outside diameter is 13½ inches and its width is 6½ inches. It is claimed that the doors carried by these bearings are the largest unit load ever carried upon anti-friction bearings. The bearings themselves are sufficiently imposing, as indicated by our photograph.—*By A. P. Child.*

The roller bearings for the Lakehurst, N. J., hangar doors

Air Takes the Place of Metal Springs

A NEW air spring device developed by a California concern eliminates the use of metal springs and shock-absorbers. Wherever spring action or suspension is necessary it is claimed that this device may be applied. The air spring consists of an inner tube, within a fabricated rubber cushion and a metal casing. A metal deformer at the bottom serves to fold the casing walls inwardly without cramping in such a way that the maximum of wear is obtained from the casing. The inner tube is filled with air according to the weight placed upon the top of the metal casing. The device is claimed to give better results, especially for light service like that illustrated, than the more usual springs.

A Key Chain That Stretches

THERE are times when the user of a key ring and chain wishes the chain were longer. With one such as this, those wishes will come true, for the chain is made of coiled piano wire and will stretch a considerable distance.—*By M. M. Hunting.*

The extensible key-chain

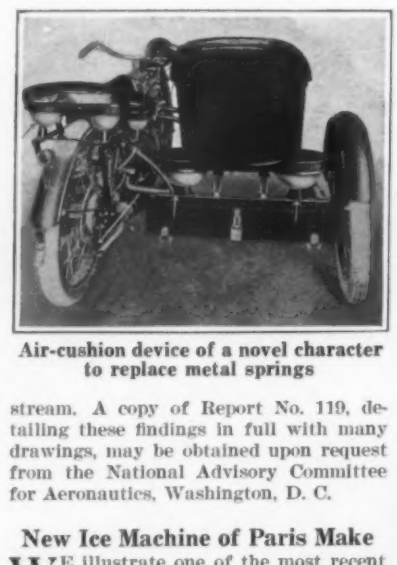
A Machine to Break-in Your New Pipe

NEW YORK boasts a dog who advertises a certain brand of tobacco by promenading about the streets or posing on window ledges, pipe in mouth and advertising placard over his back in the form of a blanket. We have listened in on acute arguments whether the animal were really smoking the pipe or just carrying it. London, however, has a machine which gives no such opening for controversy. It smokes a pipe, and leaves no doubt that it is smoking one. A tobacconist invented it and set it up in his store as a pipe advertisement, and claims that it has sold hundreds of pipes for him by attracting trade and by actual service. The non-smoker will have to have it pointed out to him that the proprietor of an old pipe frequently postpones to the last possible day the buying and the "breaking in" of a new instrument; the pipe smoker will need no argument to convince him of the value of a machine that will smoke his new pipe for him until it begins to taste like a pipe. According to our photographer, the proprietor of this ingenious machine refers to it affectionately as "Adolphus."

"Adolphus" smokes his pipe

Models vs. Full-Size Planes

INVESTIGATION of the pressure distribution over the horizontal tail surfaces of an airplane was undertaken by F. H. Norton and D. L. Bacon in order to determine whether the results obtained upon model tail surfaces can be used to predict accurately loads upon the full-sized tail; and also to find the distribution of load when large elevator angles are used, as the loads from such angles cannot be obtained readily in free flight. The method consisted in using a metal horizontal tail surface inside of which air passages connecting with a series of holes in the surface, led the pressure off from the tail in rubber tubes. In this way the pressure at each of these holes was measured by a manometer at several angles of attack and several elevator settings. The results show that the model tests give a loading which is equivalent to the loading under similar conditions in the full-sized airplane and that the manner of distribution is quite similar in the two cases when there is no slip stream. A copy of Report No. 119, detailing these findings in full with many drawings, may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C.



Air-cushion device of a novel character to replace metal springs

New Ice Machine of Paris Make

WE illustrate one of the most recent Paris productions in the way of a small and compact ice machine of patented design. It will freeze a carafe in about a minute, simply by turning the handle, and good-sized blocks of ice may be produced in a very short time. It is intended principally for domestic use, or again for medical purposes, in hospitals or laboratories, and like purposes. Outside of ordinary uses, it will be most convenient for scientific operations, as enabling quite a considerable quantity of ice to be furnished, and especially without any previous care or preparation, for one excellent point about the new apparatus is that it can be set to work at any time and is always in condition to operate.

The apparatus comprises a small air pump as seen on the right of our photograph, which can be operated by hand or by electric motor. This pump is of an improved type and is partially filled with a light oil. It is connected with a good-sized removable receptacle which contains about two quarts of concentrated sulfuric acid. A small safety chamber is disposed as observed between the pump and the container to keep these two parts properly separated and to prevent their contents from passing from one to the other. The middle container is connected by a tube with the carafe or the like whose contents are to be frozen. After pumping for about one minute, the water in the carafe will be entirely frozen. In this device the freezing action is brought about by the rapid evaporation of the water itself in the vacuum which is produced by the pump, the water vapor being absorbed by the sulfuric acid as fast as produced, so that an extremely rapid evaporation of the water is set up, resulting in an intense cold.

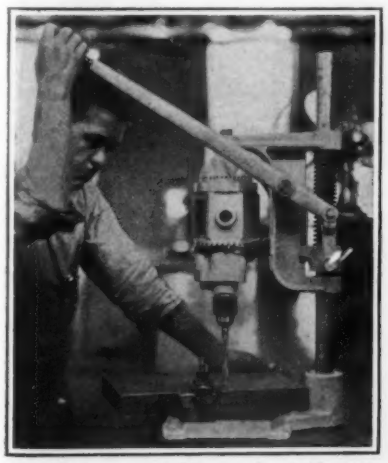
To obtain a block of ice, it is preferable to make use of a special metal cylinder which is substituted for the carafe, but is at first empty, a tube connected to the same being plunged into water contained, for instance, in a bucket. When the vacuum is produced the water gradually enters the cylinder or ice-mold through the outer connecting tube and becomes frozen within the cylinder, so

A hand-power ice machine of French design

Combination of instantaneous water-heater and tea-ball

that after about ten minutes a two-pound block of very solid ice can be obtained, which is turned out of the mold; and, of course, this operation may be repeated indefinitely. As will be observed, this apparatus is of very compact and simple make-up, and of an inexpensive nature. It can be operated by any person and without requiring the renewal of any material except the sulfuric acid, which loses its concentration as it becomes charged with water, but this product is one which may be obtained without any difficulty, and besides costs very little. For making ice cream or ices it is understood that the machine is first employed to produce blocks of ice as above mentioned, and these are broken up as usual and employed in the ordinary ice cream freezer.

As a matter of scientific interest, it may be stated that even though the device depends for its operation upon the absorption of the water vapor by sulfuric acid, it is found after conclusive official tests carried out at Paris that it will work quite as well in a dry atmosphere as in one which is saturated with moisture. Experiments made at a temperature as high as 50 degrees Centigrade showed excellent results, which proves that the machine is adapted for use in all countries.—*By Francis P. Mann.*



Combining portable and stationary features, this drill has a wide range of use

The Electric Tea-Ball

AS modern invention turns out one ingenious device after another, the possibilities of combining two or more familiar inventions into a piece of apparatus of multiple utility are always increasing. The electric heating element is one invention, and the tea-ball is another; and now we have the two combined into a single unit. The tea-ball is filled and placed in the water, as usual; only now it is on the end of a cord. The switch is turned, and the heater, which is of the immersion type, gets busy. In short order the water is boiling and the tea infusion is ready for the table.

Steel Joint Replaces Rubber Dredging Sleeve

SINCE hydraulic suction dredges were put in operation it has generally been found necessary to use rubber connections between the long pipes that are carried on pontoons. These rubber connections are not very satisfactory, as their life is very short and they require constant attention to prevent leakage along the pipe line. The illustration depicts the flexible steel joint as attached to a pontoon pipe-line. This joint is of very rugged construction and will actually outwear the pipe-line itself. By reason of a long-lipped rubber ring embodied in their construction, these joints will not leak; in fact, the higher the pressure in the pipe-line the tighter it becomes. Another ingenious feature is the locking device, which can be clearly seen in the illustration. This is in the form of a loose ring and one man can easily connect and disconnect the line almost instantly. This is an important feature, as there often are as many as 50 pipes (and 50 connections) on one line.—*By Wm. Melas.*

The Universal Flashlight

THIS flashlight may be hooked to the belt of a watchman, the fender of a car, the vest pocket of anyone, or any

Flashlight that may be hung to point in any direction

other place that is convenient or expedient. The hook moves on a ratchet, which locks wherever set. It is an exceptionally practical type of night lamp, for its rays may be pointed and maintained at any angle.

The Portable Stationary Drill

PORTABLE electric drills can be used conveniently at times when attached to a bench stand like that shown, which has a vertical column 1 7/16 inches in diameter supporting the movable drill bracket. The coiled spring forces the drill upward when not being used.

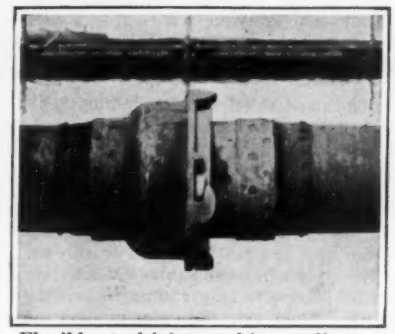
The necessary downward movement is produced by means of a lever, the arms of which are in the ratio of six to one, so that a pull of 100 pounds on the long arm will produce a drill pressure of 600 pounds, or a sufficient amount for ordinary operations. Fast work can be turned out with very little effort.

If the work is too large for the bench the drill bracket can be swung around the vertical column and clamped in the desired position for operating upon objects on the floor. The ends of axles and other high objects can be drilled in this manner.

An adjustable drill table, suitable for small work on the bench, can be clamped to the standard when needed. Drills of this kind are a big addition to any shop, on account of the wide range of usefulness and the ease of operation which it embodies.

A Better Stamp Moistener

THE end of this metal stamp affixer and letter sealer is heavy enough to prevent its tipping down and leaking water. When it is placed on a table it will automatically spring back with the moistened felt end elevated. To fill with the necessary water the ball end is unscrewed in the center, filled and securely screwed together again. Its inventor claims that it will not get gummy as many such devices do.



Flexible steel joint used in coupling up dredging pipe-line

Gasoline Gages for the Dashboard

THE need of a practical, inexpensive device for accurately registering upon the dash the amount of gasoline in the tank has long been felt by every driver of an automobile. A number of these have been offered in the past; one recently marketed appears to be sufficiently distinctive to merit chronicling. It is built for every type of car except those having the gas tank inside the cowl. It is made in two sections—the indicator in the tank, and the meter proper, located upon the instrument board.

The indicator consists of a copper, air-tight float, attached to a steel shaft, and its operation is similar in principle to the usual form of gasoline gage. The float rises or falls in the tank as the gas raises or lowers. This operates a shaft within the main indicator shaft through the medium of two brass milled bevel gears. This shaft is mounted upon two bearings. The inside shaft actuates an arm within the indicator head, and causes it to touch upon electrical segments, separate and distinct for each division of the gasoline supply.

This indicating apparatus is inserted in the tank in place of the present gasoline gage. From it is run a linen-bound, waterproof cable containing five wires, which passes under the car to the dash instrument. A connection is established between the dash instrument and the ammeter, and when the button in the center of the dash instrucent is pressed the height of gasoline in the tank is shown by means of an illumination under the section of the dial which corresponds to the height of gasoline in the tank. Both eighths and quarters register on the meter. When the tank registers ⅛, both empty and ¼ burn. When ⅜, both ¼ and ½ burn.

The General-Utility Alarm Clock

ALARM clock attachments for closing the windows when the clock goes off in the morning, or for turning on the furnace drafts, are an old story. But if the thing is feasible on a small scale like

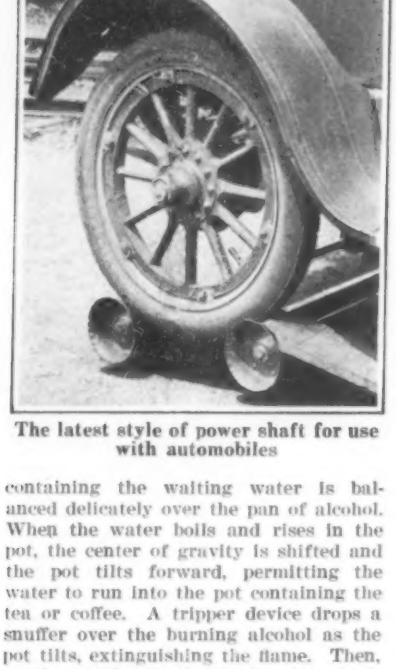
This stamp-licker is always moist

that, reasoned Walter Smith of Philadelphia, it can be equally used to bestow all the comforts of a home upon bachelors and lazy married folk who cannot afford a cook, but who like to have breakfast ready for them, steaming hot, as soon as they finish dressing in the morning. The Philadelphian has solved part of this problem by an apparatus consisting of an ordinary alarm clock, a single dry cell battery, and a few springs and weights.

With this combination he has perfected a machine that sounds an alarm, lights a fire under a pot of water and pours the water into a pot containing tea or coffee when it reaches the boiling point. Then the alarm is sounded for the second time. The inventor is now working on an attachment to boil eggs, which he asserts is a simple matter. In its present form the apparatus also lights the gas, with which Mr. Smith's house is equipped, or can be used to snap on an electric switch, thus making doubly sure that the owner will get up after the first alarm.

As shown in the accompanying illustration, the contrivance looks something like an old-fashioned clock. The alarm clock is set in the top of the box. When the alarm goes off it pulls a cord that releases a weight. This drops in such a way as to strike a match just over a shallow pan containing cotton soaked with alcohol. It also strikes a spring that turns on the gas, which is ignited by the usual electric sparker. The pot

The clock that lights the fire and starts the breakfast



The latest style of power shaft for use with automobiles

containing the waiting water is balanced delicately over the pan of alcohol. When the water boils and rises in the pot, the center of gravity is shifted and the pot tilts forward, permitting the water to run into the pot containing the tea or coffee. A tripper device drops a snuffer over the burning alcohol as the pot tilts, extinguishing the flame. Then, as the pot is emptied and swings back into place, it strikes another switch tripper that operates the alarm for a second time, this time by electricity furnished by the dry cell.

The attachment to boil eggs will be simply a duplicate of the heating apparatus without the balancing feature, the flame to be turned off by the owner when he determines the eggs are sufficiently boiled.

A New Power Take-Off for the Car

MOST devices for using the automobile as a stationary engine require either the jacking up of the rear end or the removal of one or both rear wheels. The one which we illustrate is free from both these necessities. The car is simply backed up the inclined runway until the rear wheels drop into the cradle formed by the two small driven wheels of the auxiliary mechanism at each side.

These little wheels are not so flimsy as the photograph suggests. They are formed from heavy pressed metal, each half being made separately and the two then riveted together in the center. The reason for this curious construction is of course the desire that the wheel shall form a cradle for the rear wheels of the car, without possessing itself the excessive weight that it would have if solid.

The total weight of the entire auxiliary apparatus — driven wheels, shafts, runways, etc.—is but 163 pounds. It is amply heavy enough to transmit the full power delivered to it, but still light enough to carry around readily. The only strains on the car when it is driving machinery through this mule are the ordinary ones of road driving. On account of the small diameter of the driven wheels, a "road speed" of 12–15 miles per hour by the rear end of the car will deliver power to the shaft at very high speed.

The rear shaft is the power shaft and the forward one is an idler. If more work is put on the power shaft than it can properly deliver, the car wheels will merely be thrown forward off the power shaft and on to the idler instead of out of the cradle entirely. When it is desired to move the car off the cradle, the power shaft is locked by means of a pawl and the thing is done at once. The driven wheels will take any tire up to five inches.

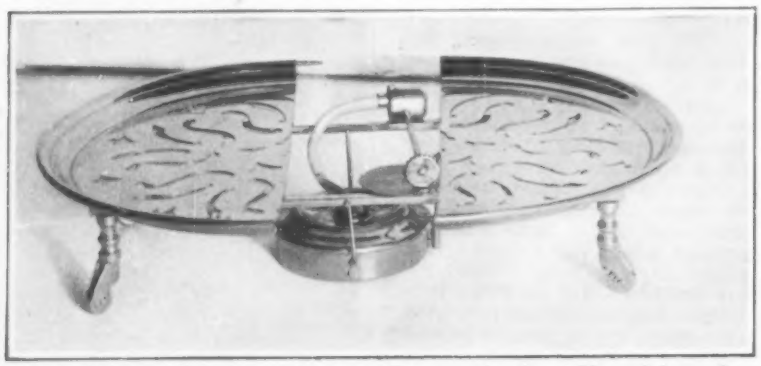
A Tickless Timepiece

TO tell time with this timepiece it is necessary that the sun shine. It is a sun watch. On the inside cover of the watch various latitudes are given. The latitude nearest your location is noted. The style, or small pointer which is seen casting the shadow on the dial, is then lifted to the angle 35, 40 or 45 degrees, the one most nearly corresponding. The variation of the compass is then noted, and the sunwatch held in a horizontal position, and the compass needle pointing to that number of degrees east or west. The sun watch will then be in correct position and the style or pointer pointing to the true north. The shadow thrown by the style will be sun time. Mean time can be determined by adding to or subtracting from sun time the number of minutes shown on the equation table for the most nearly corresponding day of the year. This table is shown on the inside cover of the watch.

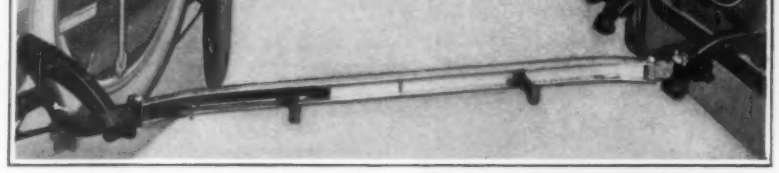
A pocket sun-dial—the tickless watch

Serving Tray Plus Stove Standard

THIS metal tray may be opened out like an extension table. In that position it serves in effective combination with an alcohol stove, which is clamped to it. The stove may be quickly removed, the tray closed, and the tray is ready to perform its more conventional function.



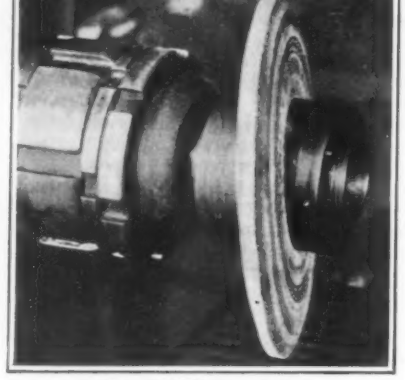
Apparently an ordinary tray, it opens like an extension table and is used as pot holder with an alcohol stove



The bumper that turns into a tow-line when emergency calls

Combination Bumper and Tow

BY means of this device the bumper can be converted into a towing device in less than a minute, and vice versa. The bumper is provided with two arms which are adapted to fit into sockets attached to the front of the springs by a swivel. This arm fits into the socket just like the ends of the old-fashioned iron beds. The arms are adjustable, adapting the bumper to all sizes and types of cars.



The wabbling grinder

At one end of the bumper there is an arm, attached by means of a universal joint. When the device is to be used as a towing bar this arm is inserted into one of the sockets. At the other end of the towing bar there is a strap, about 14 inches long, made of woven wire belting. This is for attaching the tow bar to the rear of the car that is to do the towing.

There is also a rubber bumper to protect the car that is to do the towing. This rubber bumper is provided with two slots through which the towing strap passes. After the belt has been passed around the rear spring of the towing car the free end of the belt is securely locked to the end of the towing bar by means of a cam lock. This is so arranged that the harder the pull on the strap the more firmly is the belt held.

The belt, the locking device and the arm at the other end of the bumper are all arranged to fold up into the bumper in such a manner that they cannot be observed when the device is used as a bumper. Every driver knows he ought to carry a tow-line with him, but the inconvenience of doing so leads to its frequent absence. When they come as handy as this one, however, there is not much excuse for being without one.

Sweetly Scents the Room

A RATHER novel device for the home is this perfumer, which is used in connection with electric light bulbs. The brass cap on the top of the globe is hollow. It is filled with water and a few drops of perfume placed upon it. When the light is burning, heat produced by the heated globe will evaporate the perfume and send it throughout a room. For the sick room it will be found a convenience, as well as when cooking odors have permeated an apartment as they sometimes do. Two designs are made, one as shown and a second to fit an inverted globe.

The Chemical Windshield Wiper

WINDSHIELD wipers are an old story; and so are chemical preparations which more or less satisfactorily make the surface of the glass repellant to water. Of somewhat better claim to originality is the combination of the two, so that the wiper, suspended from the top of the windshield in the conventional style, has for its bearing surfaces a chemically treated felt. The combination has the advantage over the untreated rubber scraper that it does not call for the so frequent detachment of one hand from the business of driving the car—the more ticklish in direct ratio with the frequency of the demand. It is superior to the mere chemical wash that is applied once to the glass, before starting, in that when renewal is made necessary the means of instantaneously accomplishing it in a tried and familiar fashion are at hand.

A Wheel That Grinds with a Peculiar Motion

A GRINDING wheel designed for grinding extremely thin pieces of steel in a Connecticut factory has a peculiar wobbling motion in operation. A standard grinding wheel was mounted in the usual manner in making this grinding wheel and dressed down so as to leave a very narrow face. A pair of collars was keyed to a sleeve after the collars had been machined so as to make it possible for one face of each to form an angle of 15 degrees with its axis. Being keyed to the sleeve, eliminated the possibility of their changing their relative position. A ring nut with holes provided for using a spanner holds the combination together in use and when the lead bushing is scraped out of the grinding wheel it tilts to an angle corresponding to that of the collars. The nut that would hold any other wheel on the spindle takes care of this one.

The action of the wheel presents contacts which progress back and forth over the work in right angles to the advanc-

Perfuming the room from the electric lamp bulb

The point of this scorching pencil carries heat, but no current

ing movement of the piece of work on the table. Owing to the fact that solid lines of the wheel disappear, the work is always in view of the operator.

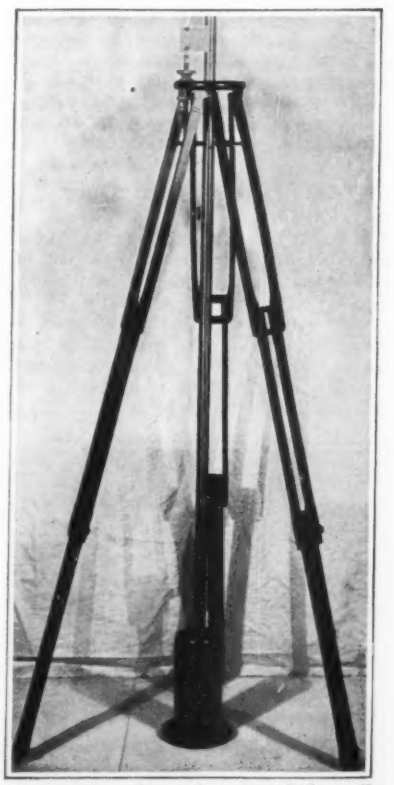
It is claimed that, in using a larger, solid wheel for grinding precisely such small pieces of steel which were required to be one inch square and 1/32 and less in thickness, there would be the danger of brushing them off the chuck or that if they were held sufficiently long they would be overheated. And it would take too long for a very narrow wheel to work over the width of the pieces. So this grinding wheel which presents a surface contact at a different location at every revolution was designed.

Rope Strength

TECHNOLOGIC Papers of the Bureau of Standards, No. 198, "Results of Some Tests of Manila Rope," gives a summary of the results of tensile tests of 368 specimens of Manila rope. Most of them represented material submitted on purchase orders for government departments. They were all three-strand Manila rope, ½ to 4½ inch diameters.

A summary of the results is given in tables and also graphically. A formula is given of the breaking load for any diameter of rope.

This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to this bureau until the free stock is exhausted.



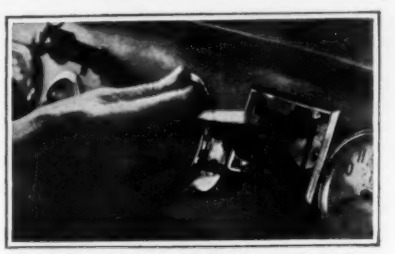
To measure the resistance of the soil to penetration—a valuable instrument in the hands of our road-builders

Electric Scorching Pencil

A NEW electric scorching pencil will find many uses in business and the various trades. It is of the stylolectric design and as a check protector it is useful and safe. Gold and silver letters can be transferred directly on many surfaces by the use of this electrically heated pen. Hat band letters can be rapidly written on the inside of your hat, and your correct address can be added if you wish. The point especially shaped for the work carries heat but no current. Electricity cannot come in contact with the user. Physicians and surgeons use the pen with a different point for cauterizing.

For the Motorist's Ashes

CIGAR ashes, in windy weather the bane and pesteration of tonneau riders who do not indulge in the weed but get its ashes in their eyes, are now deposited in this novel and decidedly ornamental ash receptacle shown in the view below.—*By F. G. Jopp.*



To keep the driver's ashes out of the passengers' eyes

Support for Swing Bridge

AN ingenious application of reinforced concrete at the works of the Société d'Electricité du Brabant, Belgium, consists of a cantilever support for the end of a swing bridge. The support had to be constructed at the angle of a building in front of which is a roadway used for continuous motor-truck traffic. The problem was complicated by the conditions that the roadway could not be encroached upon, and that it was inadvisable to disturb the foundations of the building. The solution was found in the construction outside the wall of a pilaster founded upon an extended base and provided at the top with a cantilever cap projecting two meters from its support at a height of four meters above ground level. Above the base the pilaster and cantilever projection consist of two members side by side, connected at the top by a slab 20 cm. thick, and braced at intermediate points between the base and the cap by transverse members.

Testing the Underpinning of Our Roads

A SIZE-TWELVE brogan shoe can easily plant itself in soggy soil to no avail, but an artificial foot ten inches square delivering blows from a ten-foot drop on the surface of a highway is a serviceable instrument. Reference is made to a tripod-like subgrade tester recently designed by the United States Bureau of Public Roads. The device weighs approximately 40 pounds and its ability to penetrate the soil, measured in inches, is a determining factor in appraising the value of the subgrade of the roadway being tested.

An elongated rod has a foot ten inches square, on the former being a weight which may be moved up and down. The whole contraption is supported loosely in a tripod, with a vernier measuring scale at the top. In service, the apparatus is set up over the soil to be tested, and the sliding weight is raised and dropped from a height of ten feet. Fifty blows are delivered in rapid succession to the subgrade and the penetration of the foot into the soil is revealed in inches on the vernier measuring scale.

A Mechanical Fruit Ladder

A LADDER which speeds up and lightens the labor of harvesting all manner of tree crops is the patented invention of Mr. E. A. Bixler, of Alhambra, California. Mr. Bixler, who is an orange grower himself, sought to produce some sort of machine which would simultaneously enable a fruit picker to get at his fruit, and also lower it to the ground in the process of picking without bruising or otherwise damaging the crop.

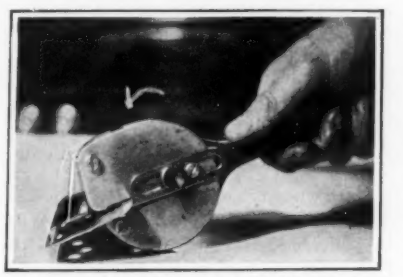
The mechanical fruit picker's ladder combines the wheelbarrow idea for moving the device about the trees and through the orchards, with the step ladder and endless conveyor belt for lowering the fruit to the ground.

The device is placed near the tree, and ascending the ladder the operator picks all the fruit within his reach. The picked fruit is merely placed in the metal buckets of the conveyor belt—and gravity does the rest. As the buckets turn over at the bottom of the belt the oranges, or whatever the fruit may be, drop out into a canvas apron. From there they are transferred to a lug box placed on a platform beneath the apron.

The device speeds up the fruit harvest by reducing the labor. Simultaneously the fruit is handled with less damage than attends most hand picking methods. It is adaptable to any kind of fruit that grows on trees, such as oranges, lemons, apples, peaches, cherries, etc.

Punch with Detachable Gage

IN order to overcome the difficulty of punching holes from the edge of metal varying depths apart, the inventor of this punch has provided a detachable gage. It has punches and dies in six sizes from 3/32 to ¼ inch, by 1/32nds. It has been especially designed for the lighter sheet-metal work of tinners with a capacity ¼-inch hole through 18-gage iron. It will punch a hole to the center of a 3¼-inch circle. It is but 8¾ inches long with a weight of but 2¼ pounds.



The punch with a detachable gage

Soap and Brush in One

SOAP and brush go together in use; why not in manufacture and sale? The manufacturer of the little novelty illustrated herewith asked himself this question, and agreed with himself that there was no answer. So we have the combination on the market today, and may enjoy the privilege of washing our grimy hands without separately picking up and applying soap and brush.

Lumber Company Has Efficient Delivery

A PROMINENT lumber company of Davenport, Iowa, delivers ready-cut buildings and lumber all over North America, Cuba and the Philippine Islands. The inner circle of this transportation system, served with motor trucks, is a model of perfection. It has been built up around the nucleus of a 2-ton truck, purchased years ago when motor truck delivery was in its infancy. The old truck is still giving excellent service, delivering its quota of building supplies every day. The company has studied motor truck transportation very carefully. Another 2-ton machine has been added. The two now take care of all the heavy work, and together with seven other lighter trucks, making a fleet of nine, duplicate the activities of about fifteen vehicles working under ordinary conditions. To state this more clearly: If the nine trucks were not so carefully routed and despatched, loaded and unloaded, cared for and driven, it would take fifteen trucks to deliver the same material in the same time and keep the customers satisfied. The motor truck fleet is operated solely for the purpose of delivering building materials in the territory comprising Davenport, Iowa; Rock Island, Moline, East Moline, Silvia and Watertown, Illinois. The territory is on both sides of the Mississippi River, in two states, and is populated by about 250,000 persons. A brief description of the mechanism by which these trucks do the work of a larger number cannot fail to be of interest.

Speeding up the fruit harvest with a mechanical ladder

Each truck, instead of having the regular platform, is equipped with cross rollers. The rest of the loading equipment is arranged mostly on the loading platform. It consists of crib bodies and crib racks. The crib bodies are loaded while resting on the crib racks and are then rolled on to the trucks. The material is loaded into the crib bodies in "station order," so the load for the last stop is the first one put on. The entire delivery district is divided into eight smaller districts, numbered from one to eight. They are so arranged that a route following through the districts from one to eight consecutively would be a continuous route, with no crossover on the back trail. All orders are stamped with numbers, one to eight, according to the districts to which they are to be delivered. The loading platform is also divided into eight parts. The

The finger-brush is now part of the cake of soap

A meat broiler of new design, intended for better conservation of the juices

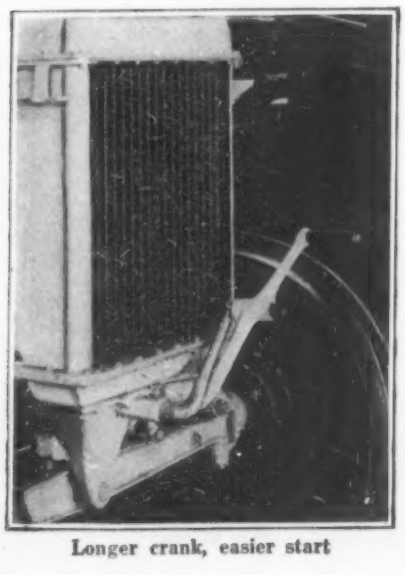
orders are simply put in the division that bears the same number and so the system works throughout.

The first truck in slips off its empty crib body and swings over in front of the loaded one. The platform men roll the body on the truck, give the driver his delivery tickets and he is off on his next trip in five minutes. Loading by hand usually requires one and one-half to two hours of hard work for driver and helper. Feeder wagons, equipped with rollers to facilitate the transfer of lumber from the wagons to the trucks, are used in the yard. The load is assembled by pulling the wagon from one lumber pile to another with a small gasoline tractor. It takes five minutes to roll the lumber from the feeder wagon to the truck. The load, secured by a chain binder to prevent scattering and breaking, is rolled off the truck at its destination in ten minutes. The driver can unload the truck without a helper. Unloading by hand, piece by piece, in the usual fashion, requires about as much time as loading.

An overhead derrick is also used to load the smaller trucks out in the yard. The load is assembled on a lumber dolly and pulled under the derrick. Then with chain slings, it is picked up and swung free. The dolly is removed and the truck run under the suspended load. The lumber is lowered to the truck and the outfit is on its way in ten minutes. The 2-ton trucks frequently carry all the material to start a house or barn 15 or 20 miles out into the country, having it on the ground in a day or so after the order is sent in.

Extension Crank Makes Starting Easier

AN extension crank recently brought out gives six inches additional leverage which is a decided advantage in cranking certain automobiles and tractors. The extension handle or crank is not permanently attached, but slips on readily over the crank attached and locks by a curved lip which extends backward.



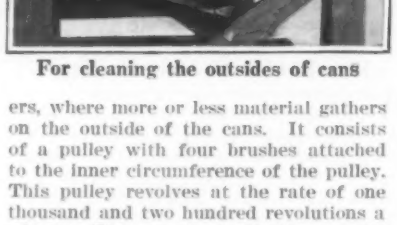
Longer crank, easier start

Makes for Healthier Stomachs

THOSE who look after our physical well-being tell us that broiled meats are kinder to our stomachs than those that are fried. The juice is kept intact so that it is more beneficial. A new device for broiling meat has been invented that is said to be smokeless, and catches all juice, broiling directly over a low gas flame. The new broiler is made in two sections, of a series of grooves, which catch the juice as it comes from the meat and direct it into the deeper groove which surrounds the raised sections. The upper section is removable for cleaning. The material is aluminum.

Device Cleans Outsides of Cans

THE accompanying photo shows a device used in canneries for quickly cleaning the outside of canned fruit, after the cans are taken from the cook-



For cleaning the outsides of cans

ers, where more or less material gathers on the outside of the cans. It consists of a pulley with four brushes attached to the inner circumference of the pulley. This pulley revolves at the rate of one thousand and two hundred revolutions a minute. The operator holds the cans in the device for five seconds. This rapidly revolving pulley is almost entirely covered by a safety device which guards the workers from being injured. The device has a funnel-shaped opening into which the cans are inserted. The pulleys carrying the brushes are operated by individual electric motors. The equipment is installed on a table which can be easily moved from place to place and is used to salvage rusty cans.—*By C. W. Geiger.*

A New Departure for the Mired Car

EVER since the first self-propelled vehicle got its driving wheels mired in a mudhole of sufficient proportions to cause them to spin in the ineffectual attempt to get traction, tradition has had it that the way to extricate the automobile from such a predicament without the aid of horses is to pass a rope from the rear axle to a tree or stake and make the car draw itself out of the soft spot by winding this rope up on the axle. But, in the words of Albert H. Geddes of Brooklyn, "many objections and disadvantages to such a method have been noted, principally the necessity of carrying a multiplicity of tools for the purpose." So Mr. Geddes has invented a scheme which is otherwise.

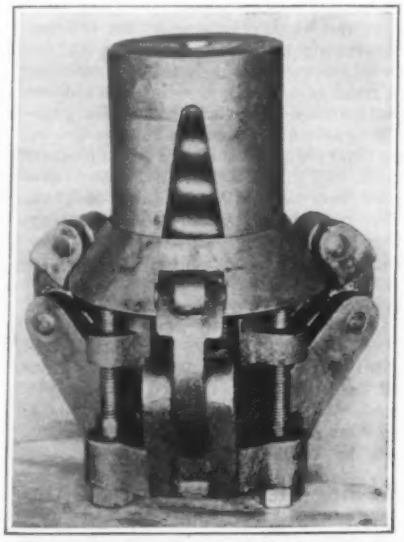
The fundamental principle of using the rear axle as a drum about which to wind a cable Mr. Geddes retains. But his departure consists in fixing the other end of the cable not to a tree or a stake, but to the front wheels! When the stalled car is cleared for action the cable is wound about a drum fixed to one of the front hubs. The other end is hooked on to a similar drum at the rear, the engine started, and the clutch engaged. The rear wheels spin, winding the cable about the rear drum—and unwinding it from the front drum. The only thing the front wheels can do, under the circumstances, is to revolve and act as temporary driving wheels. According to circumstances, the rope can be wound about both drums in the same direction or in opposite directions, so that the first speed forward—the greatest developer of power which the average car possesses—may in every case be used to run the car out of its difficulties.

One other detail is necessary to make the device operative. If the front wheels were free to turn on the steering-knuckle spindles, the action of the differential would probably be to pull upon the two front wheels with a sufficiently different pull to twist them about. This is prevented by a simple means for bolting the steering-knuckle arms to the front axle adjacent to them. The car then has no discretion save to move straight forward or straight back, as the case may be. And if one length of the rope is not sufficient to extricate it, winding it about the front drums and repeating the operation is simpler than relocating a stake.

Even Pressure in Drawing Presses

IN the drawing of metal sheets for dies, one of the most vital factors is to obtain an even, unvarying pressure during the entire stroke of the press. The spring cushion illustrated herewith was designed to meet this requirement. The use of ordinary coil springs or rubber bumpers is found to lead to back-lash of the press, hence these were abandoned. The even pressure spring cushions are attached to the press by means of a single belt, which screws into the bolster plate or into the die itself, in the same manner as rubber bumpers or coil springs are fastened.

During one entire revolution of the crankshaft the punch is descending on the blank, previously centered on the



The spring cushion which gives uniform pressure in the drawing press

drawing ring, forming the shell over the center-block. The die-pins resting on the pin plate (which in turn rests on the spring housing) force the spring housing down, compressing the spring against the spring washer. The spring washer is carried by the lower ends of the equalizing levers. When the spring housing descends, it carries with it the adjusting screws, and these allow the equalizing cam to descend by yielding to the pressure of the rollers at their upper ends. The angle of the equalizing cam together with the change in leverage of the equalizing levers compensates for the increase in spring pressure created by compression; hence we get the even pressure sought.

The Kindling-Wood Machine

OUR German correspondent puts in our hands the accompanying photograph, accompanied by a note to the effect that it is a Neuartige Brennholzer-

A German machine for chopping kindling wood

kleinerungsmaschinen. In plain English this is nothing more formidable, literally translated, than a new-sorty fire-wood-smalling-machine; only in German when they create effects of this sort it is not customary to soften the shock by the use of hyphens. The curious machine which is portrayed is intended for the production of kindling wood of a decidedly small caliber, and its use is preceded by that of a circular saw of the familiar sort, but smaller than one would ordinarily find at work on a commercial scale. The wood is fed into this saw in such a way that it is cut into strips quartered across the grain. Small bundles of these strips are then held, by hand, on each of the cutting tables of the machine which we illustrate, and which requires for this purpose two operators. The huge head, carrying its two hatchet blades, swings up and down on alternate sides like the walking beam of the old-fashioned ferry-boat; and it cuts small bits off the ends of the strips which are fed to it. Obviously it will work much faster than a hand-hatchet; but we should imagine that there might be some doubt whether it would work sufficiently faster than two hand-hatchets to pay for its initial cost and operation. However, that is another story; the machine itself is certainly a curious and interesting specimen.

An Efficient Spring Oiler

A SIMPLE and convenient means of keeping the springs of the motor car lubricated is to fasten to the end of each spring this device. The attachment consists of a woolly substance (thoroughly saturated with oil) set upon a hinge-like base. The working of the leaves releases the oil, and there is practically a constant flow as a result from this efficient little worker.

Keep the wool sponge oily, and it will keep the springs oiled

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

The old and the new: representative horse-drawn and motor-driven fire-fighting apparatus

Motor Truck vs. Horses in Fire Fighting

WHEN firemen led Dobbin and Dollie from their stalls to make room for motorized fire-fighting equipment city life lost one of its greatest thrills. Since that eventful day, many a small boy and not a few of his elders have missed the sight of the plunging horses and swaying drivers. No doubt, too, they have wondered as they watched the giant pneumatic-tired fire trucks speeding along whether it was necessary to forfeit forever the sentiment and human interest with which the horse-drawn engines, ladder trucks and hose carts were always surrounded. That the change has been a sensible one, however, has been proved over and over again in the fire departments of our leading cities. The 40 per cent increase in efficiency, due to the adoption of motorized equipment, as reported by the Chicago Department, may be taken as a representative figure. Whether it is a question of property loss or the loss of human life, motorization has quickly proved its case.

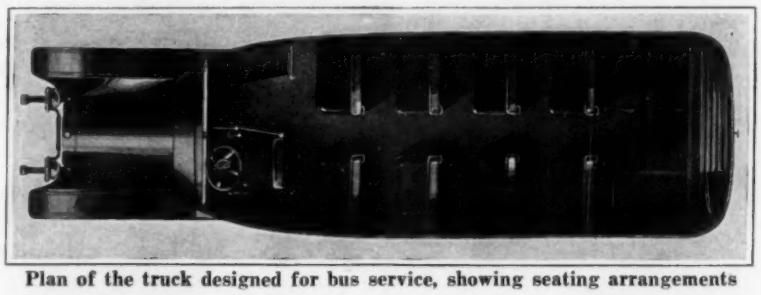
Detroit has experienced the same results as those which have been reported by Chicago, New York and other cities. In fact, it was in Detroit that the first piece of motorized apparatus was placed in service. As the first exponent of modern fire fighting, this equipment was installed in Engine Company No. 30 in 1908. This original equipment is still in service, but, of course, has been supplemented by many additional units. Today's figures show that in Detroit there are only seven engine units operating on a horse-drawn basis.

Since the purchase of the first unit, then looked upon as a doubtful experiment at best, motorized fire-fighting equipment has justified itself many times over in time, property and human life that it has saved. It operates so quickly that the all-important time element, which is the essence of fire fighting, is conserved to the utmost. Detroit departmental records cite one case where a run of 15 city blocks was made in a minute and twenty-seven seconds from the sounding of the alarm. Such performance was unthought of in the day of horse-drawn equipment, and makes possible untold savings in life and property, due to the fact that many fires are checked in the incipient stage. Further than this, motorization enables the firemen, once they have arrived at the scene of the blaze, to get into action very quickly. Especially is this true in the case of the motor-driven pumping units which have replaced the horse-drawn engines. With the motor-driven units it is possible to get up sufficient water pressure instantaneously.

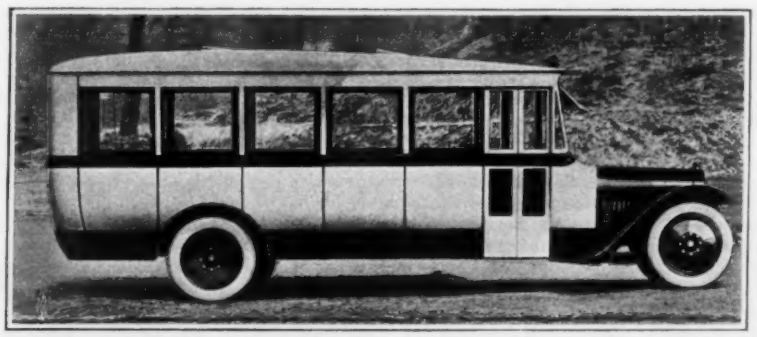
The practical value of this increased efficiency, of which the motor-driven pumping unit is but one example, is illustrated by figures which show the percentage of loss, compared to the value of property affected, in Detroit from 1915 to 1920. A reduction of one-third was made in this period, the percentage having been 9 in 1915 and 6 in 1920.

Another phase of fire fighting in which motorization plays an important part is fire prevention work. The 35,000 inspections which were made in Detroit during 1921, to discover and correct fire hazards, would have been absolutely impossible without the aid of a highly mobile and efficient motor squad. When it is borne in mind that in 1921 Detroit suffered from 508 less fires than it did in 1920, and reduced its fire loss more than $1,000,000, the value of such a service will be readily appreciated. And not only does the use of motor equipment operate to the advantage of the Fire Prevention Bureau, but it assists immeasurably in the work of other bodies.

From the taxpayer's standpoint, motorization has proved a genuine economy. Although the personal comfort and welfare of the firemen have been greatly improved, the operating expenses are much less than they were in the horse-drawn régime. The horse was an item of expense 24 hours a day. Feed, bedding and veterinary attention and many other necessities figured largely in the annual appropriation. Through the adoption of motorized methods all of these expenses have been reduced merely to a matter of gasoline, oil and tires.



Plan of the truck designed for bus service, showing seating arrangements



This view of the new bus emphasizes its low hanging and the consequent stability and convenience

New Model Designed Solely for Bus Service

A SPECIAL type of motor bus having new features of design which are important in passenger transportation but not available in the conventional types of motor truck chassis, has been brought out by a well-known motor truck manufacturer of Cleveland. The new design is one of the first in which both chassis and body have been developed especially for bus work. It gives railway companies and bus companies the advantage of using equipment that exactly fits the needs of bus operation.

The new model, which is illustrated herewith, has a wheelbase of 198 inches, making it possible to mount, without excessive overhang, a body which has comfortable seats for 25 passengers. Long and flexible springs, a low center of gravity and the long wheelbase combine to make riding easy. Because of its low loading height only one step is needed at the entrance. Passengers can enter or leave rapidly so that stops are short and fast schedules can be maintained. Two types of bodies have been designed for the bus chassis—one known as a city type and the other an interurban type. Operating companies, however, may use other types of bodies when desired. The city type permits of great freedom of movement about the interior and eliminates "choking" at the entrance. The interurban type is designed for the utmost comfort of passengers on long trips, with ample space for luggage. Both types have wide double doors at the front and an emergency door in the rear.

Standard equipment includes generator and electric lights, side braces on the frame, steel wheels and solid tires, single in front and dual in rear. The tire equipment is especially adapted to operation on city streets. Pneumatic tires and disk steel wheels can be furnished, if desired for interurban operation. This tire equipment does not raise the low center of gravity nor increase the frame height. The use of various optional standard gear ratios makes possible a wide range of speed and acceleration. In the manufacture of the bus chassis the well-established and experienced company has endeavored to give it the highest possible earning capacity.

Sir Ernest Shackleton

WHILE his ship, the "Quest," was lying at anchor off South Georgia Island, lonely outpost of the Falkland Island colonial administration, Sir Ernest Shackleton, the Antarctic explorer, died of heart disease on January 5th. The news of his death reached the civilized world only on the 29th of the month, with the arrival at Montevideo, Uruguay, of the Norwegian tramp, "Professor Cruvel," bearing the body. Sir Ernest died of heart disease which, so far as we know, had never been observed to be constitutional with him. He had been slightly under the weather on retiring the previous evening, but nothing was thought of this. At 3:30 A. M., however, he underwent a sudden collapse, and died within three minutes.

Shackleton was born on February 15th, 1874, at Kilkee, in the south of Ireland. He was the eldest son of the local physician. He was educated at Dulwich College and then entered the merchant marine. In 1901 he was third lieutenant of the National Antarctic Expedition, under the late Captain Scott. The interest in such work which was aroused at this time remained with him for the rest of his life, and supplied the driving influence for most of his later activities. He first became prominent in the field of Antarctic exploration when he commanded the British Expedition of 1907-09. On this trip Shackleton attained the farthest south record of 88° 23', only 97 miles from the pole—a mark which was surpassed only when Scott and Amundsen later reached the pole itself. The expedition of 1907-09 was perhaps the first of the south pole explorations which brought back scientific results of large value. In addition to the relocation of the south magnetic pole, the party collected meteorological, biological and zoological data of real consequence; and made as well notable additions to the technique of polar exploration itself.

Shackleton's most dramatic voyage was the one of 1914-16. The program here was to cross the south polar continent from sea to sea. Although this idea was not put into successful execution, and although the expedition brought back scientific results of relatively small value, the enterprise turned out to be by all means the most adventurous onslaught ever made by man upon the polar regions at either end of the earth. The ship, the "Endurance," entered the ice near South Georgia in December, 1914, and a year later was crushed at a point to the east of Graham Land. From this date, November 24th, 1915, until April 9th, 1916, the party drifted with the ice floes. On April 9th, 1916, they encountered for the first time sufficient clear water to justify the launching of their boats. Six days later they landed on Elephant Island, 300 miles from South Georgia. Shackleton and five of his men presently set out in a 20-foot open boat through snow, high winds and heavy seas. This sortie was successful, an inlet on the wrong side of South Georgia being made in safety on May 16th. With the two men who remained in best condition for the trying trip, the commander then set out through the interior of this desolate island, mountainous and glacier-covered, and reached the whaling station in Stromness Bay, on the north side of the island, from which the "Endurance" had sailed in 1914. Shackleton must have presented a good deal of an apparition to those in charge of the station, and the extraordinary character of the whole incident was in no wise abated by his first question—a demand to know when the war had ended!

After sailing around and picking up the other members of the emergency expedition, it was next in order to undertake the rescue of the 22 men left behind on Elephant Island. After three failures, he finally got to them and brought them off in a Chilean tug. It then developed that there was more rescuing to be performed. The "Aurora," which had been sent around to the New Zealand side of the antarctic continent to await Shackleton's arrival and to pick him up, had been driven off to sea while ten of her men were on the ice, and had been so badly crippled that it was with difficulty her navigator was able to make a New Zealand port. Characteristically enough, nobody seems to have worried much about the ten marooned men until Shackleton himself got wind of their plight. Three of them, it turned out, had died; but the surviving seven Shackleton brought off to New Zealand.

It might have been thought that this experience, coupled with that following his 1907-08 expedition, would have been enough. In 1910, it will be recalled, after the British Government had repudiated the costs of the 1908-09 journey, Shackleton met as much of them as he could from his own resources, and then undertook a lecture tour of this country to raise the balance so that he might reimburse his friends who had advanced the funds to make the expedition possible. But neither this nor his adventurous time of 1914-16 damped his ardor, and in September, 1921, he left England on what was destined to be his last exploration. He was to be gone two years, and cover some 30,000 linear miles of uncharted waters in the Antarctic region. After damage incurred from rough water off Portugal, the "Quest" laid up in Rio de Janeiro for repairs; and it was from this port on December 18th that Shackleton made his final departure from civilization in the little 200-ton craft.

It was his human side that made Sir Ernest Shackleton such an interesting personality. He was a man of fine impulses, of great fearlessness and of unlimited enthusiasm for his work. He was modest in the estimate of his own accomplishments; always fair in awarding full justice to his subordinates; and more than generous in his recognition of the achievements of other explorers.

Sir Ernest Shackleton

German Scientific Books

DESPITE the severe conditions which we must believe the depreciation of the mark to have brought about in German industry, especially of the less essential sorts, the German publishers are beginning to get into their stride again after the long hiatus of actual war times. Within the past few weeks we have received from a single publisher, W. Engelman of Leipzig, copies of a number of volumes that indicate this. None of them is a new production from the point of view of authorship, but all are new editions, and in some cases it is clear that the entire volume is from new type.

Perhaps the most interesting of these items is a sixth edition of Newcomb's *Popular Astronomy*, which carries the name of Dr. Ludendorff on the title page as responsible for the German form of this edition. The text, tabular matter and illustrations are well up to the high mechanical character of German prewar scientific books.

Another old friend whose tenure of life has been restored by a new printing is Kowaleski, *Die Klassischen Probleme der Analysis des Unendlichen*. In the new edition as in the old we have an admirable example of the ability of the German typographer to deal elegantly with complicated mathematical notation. No mathematical library may be considered complete without this work.

For some time it has been the unfortunate case that trigonometric and logarithmic tables of more than four or five places have been either altogether out of print, or obtainable only at exorbitant prices. It is therefore a pleasure to chronicle a reprinting, apparently from the old plates, of Peters excellent seven-place tables, and likewise of the eight-place tables in two volumes that bear the names of Bauschinger and Peters. The former gives trigonometric functions (in the logarithmic form) only; the latter gives as well the logarithms of numbers up to 200,000. In both volumes the trigonometric tables are presented for every second of arc.

There appears to be just one drawback in regard to these volumes and others like them. When they were prepared, a little printed card was got up to accompany them abroad, explaining that owing to the exchange situation a premium of 50 per cent over the quoted prices would be required of all overseas purchasers. Before they were sent out it was found necessary to alter this figure by rubber stamp to 100 per cent; and in the case of those most recently received, the "Valuta Aufschlag" has gone up to 200 per cent. We have had several experiences of late which demonstrate that the surcharge which the canny German tries to make for the doubtful privilege of doing business in his utterly worthless currency customarily multiplies itself by two or three during the interval between his quotation of a price and his customer's acceptance. We don't know just how one can do business on this basis, save by keeping constantly in mind that the quoted price in marks is so low (not more than 150 marks for any of the above volumes, fairly well bound) that if one really wants them one can afford to pay pretty nearly any fine which the publisher may seek to impose upon him for the privilege of purchasing them.

George Baldwin Selden

THE last echo of a *cause celebré* was heard when the daily press of January 17th chronicled the death in Rochester, N. Y., of the Selden patentee. Mr. Selden will be remembered as the inventor who collected royalty for many years from the bigger half of the American automobile industry on a patent which claimed the aggregation of engine, clutch, fuel tank, carriage, etc., into an automobile; but which really did not cover the modern gasoline automobile at all. He had filed his application in 1879, and by exhausting every artifice permitted under Patent Office procedure, had kept it "pending" until he was obliged in 1895 to accept its issue. Only when the patent was within a few months of expiration was his prosecution of unlicensed makers finally thrown out of court.

Mr. Selden had believed in the future of the automobile, and had planned to capitalize that future by means of his patent. But he had regarded the constant-pressure, slow-burning Brayton engine, not really an explosion engine at all, as the ultimate type, and had specified it more or less explicitly in his claim. One is led to wonder whether he was not in ignorance of the existence of the Otto engine; for it seems that it would have been easy to broaden his claims to include any gas engine using liquid fuel. In any event, the automobile was developed commercially using the Otto explosion engine; so that the Court was ultimately able to decide that the Selden patent, while valid in itself, was not infringed by any of the defendants against whom suit had been brought under it. We may infer that the Court reached this decision with a certain degree of satisfaction, for Justice Hough in the opinion stated: "No litigation resembling this case has been shown to the Court, and no instance is known to us of an idea being buried in the Patent Office while the world caught up to and passed it, to be then embodied in a patent useful for tribute only."

Throughout the long litigation under the Selden patent, the SCIENTIFIC AMERICAN had maintained this viewpoint, and had been outspoken in its condemnation, on legal, technological and moral grounds alike, of the patent and the effort to levy upon the industry through it.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Many Uses for Little-Known Mineral, Bentonite

ACCORDING to a report made by R. B. Lados of the Bureau of Mines, the little-known mineral, bentonite, possesses certain unusual chemical and physical properties which makes it useful in a large number of ways in industry. The name itself is not descriptive of a single mineral, but of a group of clay-like materials which contain an alkaline oxide and an alkaline earth content of 5 to 10 per cent. The grain size is fine, the minerals possess high absorptive powers and are colloidal in nature. The physical and chemical properties vary quite widely as there is no fixed composition of the mineral.

Up to very recently the uses of bentonite were very limited and of comparatively slight importance. It was used largely in the manufacture of the medical dressing known as antiphlogistine, in the manufacture of a packing and dressing for horses' hoofs, as retarder in the manufacture of gypsum wall plaster, as a filler in the manufacture of paper and soap, and as an adulterant in the preparation of drugs and candies. However, the peculiar properties of the material have stimulated investigations to develop new applications for it, and lately careful study has been made of this material, with the result that a whole series of new uses for the same has been evolved.

In the manufacture of soap it has been found that certain of the bentonites can replace as much as 25 to 50 per cent of the soap substance and still give a product that is as good as ordinary soap in every respect. Other members of this class of minerals have been known to make very effective adhesives, especially a paste with which paper can be made to adhere to metal. The claim is that labels pasted on metal with a bentonite glue will not curl up and drop off. The fact that bentonite has such a great absorptive power for water has suggested a possible use in the dehydration of crude petroleum and other oils. Other uses that may be mentioned are: as a base for massage creams, a base for the manufacture of lake colors, for printers' ink, as a heavy lubricant or grease when mixed with oil, and as a filler or dressing for leather.

New Uses for Sulfocyanates

THE sulfocyanates are recovered in the manufacture of gas. The cyanogen compounds in the gas are removed therefrom by passing the latter through purifying media, usually iron oxide, and the sulfocyanates result from a combination of the sulfur with the cyanogen and the iron of the purifying mass. Most of the attention paid by gas plants to this product in recent years has been along lines of getting rid of it by conversion into ferrocyanides rather than in the way of constructive development of new uses.

H. E. Williams in the *Journal of the Society of Chemical Industry*, 1921, pages 221 to 224, calls attention to the fact that sulfocyanates can be used to good advantage in the manufacture of parchment paper, "vulcanized fiber" from cellulose, of mercerized cotton, and in filament spinning. The parchment paper is made by dipping the paper in a solution of calcium sulfocyanate and calcium chloride at the boiling point. A very strong parchment paper is obtained in this way. The vulcanized fiber is made from the parchmentized paper by retreating the same in a second bath of calcium sulfocyanate. The paper is then pressed between rollers. A product is obtained in this manner that resembles vegetable ivory very closely. It can be sawed, turned on a lathe, perforated and machined in any way. It will also take a high polish.

Paper from Oat Hulls

ACCORDING to S. D. Wells in the *Paper Trade Journal*, oat hulls can be used to good advantage in the manufacture of paper pulp and strawboard. The oat hulls are digested with lime. The cost of the product should not be higher than that in the manufacture of pasteboard from straw. The strength of the oat hull product is not as great as that of the straw product, but by admixture of the two raw materials a very tough paper may be obtained. In making pulp from the oat hulls, the latter are mixed with cotton linters or cotton hull fiber and treated according to the sulfate process. The high yields that are obtained and the good quality of the product indicate a promising source of pulp for the manufacture of paper used for printing books, magazines, for writing purposes, etc.

Compression of Zinc and Zinc Alloys

EXPERIMENTS have been made recently in Germany with the view of increasing the strength of zinc and brasses by subjecting the metals to compression. In one case zinc containing about 1 per cent lead with traces of iron and cadmium was so improved by the compressive process that the product appeared to be almost a new metal. Because of the non-uniformity of the results obtained thus far, the process has not received any considerable application

Nitrated Coal, a New Raw Material for Paints and Varnishes

WHEN finely ground, air-dried lignite coal, containing about 25 per cent of water, is gradually introduced into a mixture of nitric and sulfuric acids, five times the weight of the coal, and consisting of 7.5 parts of concentrated H_2SO_4 and five parts of HNO_3 (specific gravity 1.42), there is obtained a product which is a nitrated derivative of the original coal. The nitration is conducted at the ordinary temperature, and the coal is permitted to remain in contact with the acid for about an hour. At the end of this time, the mixture is poured into water, the precipitate is sucked off and washed with water. The nitrated product is reddish brown in color, somewhat lighter than the original coal, and contains 3.8 per cent of nitrogen. It is soluble almost completely in acetone, pyridine, dichlorhydrin, as well as in a mixture of benzol and alcohol. The yield is almost 100 per cent.

The pyridine solution of nitrated coal can be diluted with water, without the solution becoming turbid. The solution foams just like a solution of soap, although not so strongly; it is precipitated by various mineral acids, barium chloride, silver nitrate and other salts. The salt, obtained when the solution is precipitated with calcium salts, contains 6.3 per cent CaO. The nitrated coal is colored a brownish black with alcoholic potash solution; if the caustic solution is poured off and the residue is taken up with water, then there is obtained a deep black solution, which behaves towards acids and salts just like the pyridine water solution. The solutions of nitrocoal in acetone or benzol-alcohol leave behind on evaporation a lacquer-like film. This makes it possible to use the product in the paint and varnish industries.

New Nitrate Lands in Chile

ACCORDING to the Commerce Reports, it is claimed that a new deposit of nitrate of soda over a district of 2000 square kilometers has been discovered in Chile. No soda was known to exist in this region heretofore. The deposits lie 11 feet under the surface and the beds contain 20 to 40 per cent of nitrate.

A Chemically Controlled Automobile

THE production of power in an automobile engine is not a simple affair, as may be supposed, but depends on a complex chemical reaction. To get the most miles out of a gallon of gasoline is equally the aim of the owner of the high priced car as well as of the lowly Ford. Realizing the nature of the process which converts the liquid gasoline into mechanical power, there remains but one way in which the maximum efficiency can be obtained from the fuel and that is by chemical control. G. G. Brown in the *Journal of Industrial and Engineering Chemistry*, 1922, 6, gives the results of his very interesting and enlightening experiments on the operation of the automobile engine under chemical control.

The important thing is to secure the proper mixture under all conditions of operation. Very careful tests revealed the fact that the maximum efficiency is obtained with a hot dilute mixture. The colder the engine, the more concentrated the mixture must be in order to maintain the velocity of reaction above the critical point necessary for explosion. A special form of carburetor is described, which is controlled automatically and according to chemical principles—that is, to give the proper mixture of air and gasoline under all conditions in the engine, so as to obtain the maximum mileage from a gallon of gasoline.

The exercise of chemical control to obtain complete combustion of the gasoline and hence maximum power resulted in increases from 25 to 100 per cent in the mileage per gallon. The Ford car, which will average about 19 miles to the gallon ordinarily, will give 30 miles to the gallon with chemical control. A heavy car of eight or more cylinders, giving 8 miles to the gallon under ordinary circumstances, will run 18 miles to the gallon with chemical control.

New Leather Grease

ACCORDING to the *Chemische Umschau*, 1921, 244, a new leather grease, which may also be applied to chrome tanned leather under certain conditions, and which is considerably cheaper than the animal fats used up to the present time, is made from mineral oils. The oil is mixed with a calcium soap which overcomes the disadvantage of the same, causing the leather to become hard and brittle. Neutral fats or fatty acids are also added in order to make the mixture emulsifiable with water and hence applicable to wet leathers. The process consists in heating the mixture of fatty acids and mineral oils to 110 degrees C. and then stirring in the calculated quantity of calcium hydroxide gradually. The mixture is allowed to stand, when transferred to a mixing pan, warm water is added and the whole is stirred until cold. A sample analysis of such a product is 8 per cent of calcium soap, 8 per cent of neutral fat, 64 per cent of mineral oil and 20 per cent of water.

Nitric Acid Made with Ozone

A PATENT has just been issued (see United States Patent No. 1,400,912) on a novel process of making nitric acid by the oxidation of ammonia with the aid of ozonized air. The ammonia itself is produced by the treatment of cyanamide with steam, and it is claimed that the ammonia in this nascent state can be oxidized very readily to nitric acid with a comparatively small production of nitrous oxides. The apparatus used in the process consists of a spherical receptacle provided with a cover which can be secured to it very tightly by means of bolts. The whole apparatus resembles an autoclave very much. In about the center of the apparatus there is a circular perforated diaphragm on which the cyanamide is placed. After the cover has been bolted into place, steam is added through an opening in the cover and the cyanamide is decomposed with the formation of ammonia, which passes through the diaphragm into the lower half of the apparatus. Ozone is then admitted through the bottom and mixes with the ammonia, oxidizing it to nitric acid, which is discharged through a bottom outlet. The process is very interesting, for it gives practically all nitric acid and avoids the use of towers and other oxidizing apparatus to convert the nitrous oxides, ordinarily obtained in the ammonia oxidation process, into nitric acid.

New Oil-Hardening Process

AS is known, the hardening of oils, which in other words is also called the hydrogenation of oils, consists in treating the oil with hydrogen gas, whereupon the oil absorbs the gas and the former is converted into a solid fat. To assist in the process, catalysts are used, substances which cause the action to take place more quickly and with better efficiency than when they are absent, and which in themselves suffer no change during the treatment. According to the Italian journal, *Giornale di Chimica*, October, 1921, a new catalyst has been found, which is the double silicate of magnesium and nickel, and which it is claimed gives very remarkable results. One of the great improvements worked by the new catalyst is the production of absolutely white solid fats from dark colored oils, which in the former methods of hydrogenation have to be purified first before conversion into a fat.

Increasing the Flash Point of Cylinder Oils

ACCORDING to the *Seifensieder Zeitung*, a very effective method of raising the flash point of cylinder oils is to add to them from 3 to 15 per cent of the aluminum salt of fatty acids.

The Heavens in April, 1922

The Observations on Venus' Atmosphere, and Some Plausible Deductions That May Be Drawn Therefrom

By Prof. Henry Norris Russell, Ph.D.

IT has been known for a century and more that Venus has an atmosphere. Indubitable evidence of this is afforded by observations made when she is nearly, but not quite, in line between us and the sun. She then appears, of course, as a very narrow crescent, but is so bright that she is conspicuous in even a small telescope. When the sky is clear it may then be noticed that the thin horns of the crescent extend considerably beyond the half-circle that marks the limit which they can attain on such a body as the moon. Under favorable conditions, when Venus is very close to the sun in the sky, the crescent may extend over three-quarters of the circle, or may even close up, so that the planet appears as a luminous ring. Such a phenomenon can be produced only by an atmosphere surrounding the planet. Looking past the planet's edge, we see the illuminated atmosphere—sometimes all around the dark edge of the disk.

Though it is thus made certain that Venus has a gaseous envelope, this must be much less extensive than the earth's—for the part of it which, when lit up by the sun, is bright enough to be seen through the illuminated foreground of our own daylight sky, extends for only about 60 miles over the night side of the planet, and has a depth of less than one mile. The earth, seen through a similar sky in a like position, would show far more conspicuous effects of twilight, and a much greater prolongation of the horns of its crescent; so we may conclude that there is much less atmosphere above the *visible surface* of Venus than over the earth. The proviso is necessary, for it is possible that Venus' surface, which is very white, is composed of clouds; and there may then be any amount more of atmosphere below these.

If we seek information regarding the composition of this atmosphere, we must employ the spectroscope. As everyone knows, some of the gases of our own atmosphere—oxygen and water-vapor—absorb light of certain wave lengths and give rise to dark lines in the spectrum. These atmospheric lines can be observed in the spectrum of a terrestrial light-source a mile or two away; and they are conspicuous in that of the sun, growing stronger as the sun sinks toward setting and its rays traverse a longer path in the air. The water-vapor lines, moreover, change greatly with the weather, being faint on cold, dry days and strong on hot, damp ones, when the air is steamy.

Now if we could live and observe on the moon, which has no atmosphere, we would not find these lines in the spectrum of the sun; but the light reflected from the earth, having passed twice through our atmosphere, would show them strongly. We could thus be sure that these constituents were present in the earth's atmosphere—and, of course, we could apply the same test to all the other planets from which we could get sufficient light to work. As we are, we must observe from the earth's surface, through our own atmosphere; so the absorption lines which are there produced we find in the spectra of all celestial objects. If a planet has an atmosphere, too, containing oxygen, we will get the combined effects of its atmosphere and our own. If the planet's atmosphere contains more oxygen than ours, the resulting lines will be heavy and we can detect this oxygen by comparison with the spectrum of the moon, where only our own atmosphere is effective. But if the planet's atmosphere is poor in oxygen, the terrestrial effect will drown out the feebler planetary one.

To separate the two, St. John has now used an ingenious method, previously employed by Campbell. With a powerful spectroscope of very high dispersion he has photographed the spectrum of Venus when near elongation, and rapidly approaching or receding from the earth. At such a time the lines in the planet's spectrum (whether produced in its own atmosphere or previously present in the sunlight itself) will be shifted to the violet or the red, in accordance with the well-known principle of Doppler. The lines absorbed in the earth's atmosphere will, of course, undergo no shift. By choosing our time, and using a powerful spectroscope, we may get the two sets of lines—planetary and terrestrial—fairly well separated, so that if there were absorption in both atmospheres, each line of oxygen (for example) would appear as a close double.

When the experiment was tried Dr. St. John found no trace of doubling. The terrestrial lines were there as usual; but not even a suspicion of those which should be produced by oxygen in the atmosphere of Venus, although it was known exactly where they ought to appear. The water-vapor lines yielded precisely the same result, and repeated photographs, on different days, confirmed the conclusions.

There can be no doubt, therefore, that the atmosphere of Venus is devoid of water-vapor, and of oxygen, too. By comparison with laboratory experiments on the absorption in our atmosphere, St. John concludes that the amount of oxygen above Venus' surface cannot exceed the thousandth part of that in the earth's atmosphere. For water-vapor the test is less delicate, but the maximum amount upon Venus can be but a few per cent of that which is ordinarily present here.

This result—which is confirmed by observations made by Slipher in another way at the Lowell Observatory—appears at first sight very extraordinary. Venus and the earth are twin planets—very similar indeed in size, mass and density. The only great difference between them is that the whole surface of Venus is covered with some white substance, while only half that of the earth, on the average, is similarly clad (with clouds). Both planets are massive enough to retain water-vapor permanently in their atmospheres. Why, then, should Venus be waterless?

The difficulty may be escaped if we adopt the assumption, which seems reasonable in other ways, that the visible surface of Venus is composed of a permanent layer of clouds. We know that, on earth, the temperature of the atmosphere falls steadily up to a height of some 10 miles, and beyond this remains nearly the same. In the lower part of our atmosphere, vertical currents, ascending and descending, are continually at work. The water-vapor evaporated from the oceans these currents carry to higher levels, where it condenses to form clouds.

But in the upper, or "isothermal" layer, there is little or no vertical streaming—the uniformity of temperature prevents it. So practically no water-vapor gets into this region: the air there is dry and always cloudless. The upper boundary of the region of clouds is marked by the familiar wispy cirrus clouds, which lie so high that no man in balloon or airplane has ever looked upon their upper surfaces.

If the circulation in the atmosphere of Venus is similar, and if, as seems probable, evaporation from its oceans is more rapid than from ours, it may well be that its atmosphere contains a permanent layer of high cirrus clouds, at the very top of the region of vertical circulation. The atmosphere above this would belong to the isothermal layer, and would contain practically no water-vapor. Whether or not this is the true situation on Venus, it seems clear that an observer on some other planet, working spectroscopically on the light reflected from the earth in a region covered with high cirrus clouds, would get much the same results, with regard to the water-vapor lines, as Dr. St. John got on Venus.

But such an observer would still get oxygen lines in the earth's spectrum—for the proportion of oxygen in the isothermal layer is about the same as in the lower air. Moreover, this layer contains at least 10 per cent of all the oxygen in our atmosphere, and hence at least a hundred times as much as there can be upon Venus.

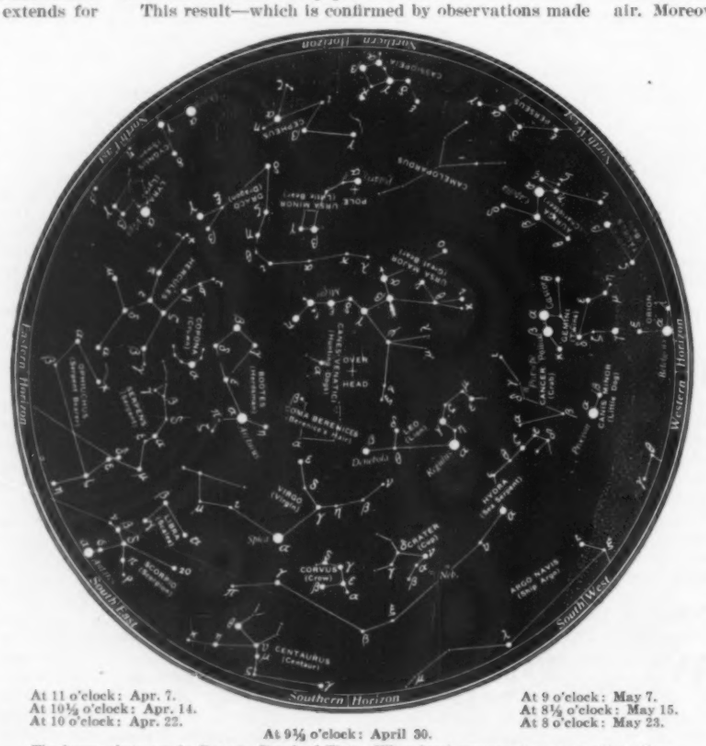
Here there seems no escape from the conclusion that the atmosphere of the planet actually contains no oxygen. This settles one question immediately and drastically. Without oxygen in Venus' atmosphere there can be no animal life, as we know it, on her surface; for all animals, on land or sea, breathe oxygen, free or dissolved. Moreover, there can be no vegetable life of the sort which covers the earth; for if such vegetation flourished on Venus it would gradually fill her atmosphere with oxygen. Hence we conclude that Venus is a lifeless world—unless, indeed, life exists there in forms essentially different, in their fundamental metabolism, from those which occupy our planet. Concerning such a possibility we have no basis for speculation except that afforded by pure imagination.

Though we accept the conclusion that there is no life on Venus because there is no free oxygen, the latter fact still seems itself strange. We instinctively assume that all atmospheres would contain oxygen. But is this reasonable? Free oxygen is a very active chemical agent, and is continually being used up by all sorts of natural processes, including many that are entirely inorganic. The earth, as a whole, appears to be far from saturated with oxygen; the freely oxidizing materials existing beneath its surface are of such sort and in such quantities that if the whole globe were reduced once more to a molten mass, and well churned, we might expect the existing free oxygen to be consumed chemically.

This suggests the hypothesis—possibly bold but not unreasonable—that the free oxygen of our atmosphere is a product of terrestrial life: the slow accumulation of the activity of vegetation through millions on millions of years. The oxygen may originally have been there in chemical combination. In setting it free a vast quantity of carbonaceous material must have been formed, and we must infer that this lies buried in the sedimentary rocks—as coal beds, as oil, bituminous shales, scattered portions of organic matter, and other products of chemical reduction. The total quantity necessary to account on this basis for the entire oxygen content of the atmosphere is equivalent to a layer of coal covering the earth's surface, and a little over a foot thick.

It is therefore possible that our terrestrial oxygen is itself the great evidence that life exists on our planet. The familiar oxygen bands in the spectrum then take on a new and deeper significance. Descried from afar with the aid of the spectroscope, they are the sign and signal, legible to the far-off planets should any of them be able to read it, and telling "Here is Life."

The usual schedule of the planets will be found on a later page.



At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.

At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

At 9½ o'clock: April 30.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

How to Keep a Car in Running Order

To the Editor of the SCIENTIFIC AMERICAN:

We have read with great interest the article on page 39 of the November issue of SCIENTIFIC AMERICAN entitled, "Some Simple Pointers on How to Keep a Car."

We wish to call your attention to the fifth paragraph in which the statement is made that "oil should be drained from the crankcase once in three months and new oil applied." We feel that you should check up statements of this kind, as they are apt to be a little misleading. It is the opinion of our automotive engineers, and it is also the policy of our company to recommend the draining of automobile-engine crankcases at regular intervals.

Periodic draining of the crankcase is necessary for several reasons. In the first place, it is only by draining that we can free the lubricating system of the accumulation of grit, metallic sediment and carbon which tends to build up as the oil is used over and over again.

The circulation of this non-lubricating, and sometimes abrasive, material is harmful and should be guarded against.

Likewise, there is always a tendency for the oil in the reservoir to become diluted with fuel. This fault is especially prevalent during winter operation where the carburetor choke is used excessively or where, in order to obtain easy starting, the carburetor is adjusted for an over-rich mixture.

A frequent cause of excessive dilution and one which, unhappily, is often overlooked even by the most competent repairmen, is choking of the exhaust gas passages through the manifold hot spot. Such choking stints the supply of heat to the manifold; heat which is essential to insure thorough vaporization of our present-day fuels.

The presence of fuel in the oil naturally reduces its body and consequently impairs its lubricating value.

It has, however, another and an even more serious effect. It greatly reduces the clinging and sticking properties of the lubricant.

Oil which is badly diluted, therefore, instead of clinging to and protecting the bright metallic surfaces within the crank chamber against rust and corrosion, drains off quickly and leaves these surfaces exposed to the precipitation of moisture and the rapid accumulation of rust which is, of course, a mighty serious factor in promoting wear.

Chiefly affected by this corrosion are the cams, cam followers, and the silent chains which are used for camshaft and accessory shaft drives on about 45 per cent of our present-day cars.

A further thought on the necessity for draining is the fact that however free from acid a fresh motor oil may be, all mineral oils in service acquire a certain amount of acidity, sometimes to a harmful degree.

The source or sources of the acids which are formed is not well understood, nor is the nature of the acids fully defined. Some acidity is probably attributable to the fuel. However, mineral oils employed in service where liquid fuel is not present, exhibit this same tendency to become slightly acidulated after hours of service.

The presence of this acid is not particularly harmful, provided the oil has not lost its clinging properties, and will coat and protect the bright surfaces. When the oil is badly diluted and drains from these surfaces, any acid present quickens the process of rusting.

Our automotive engineers recommend the following with respect to crankcase draining: On new cars, drain the oil from the crankcase and refill with fresh oil after the first 500 miles of service.

After this initial draining, drain and refill the crankcase with fresh oil after every 1000 miles of operation during summer weather. During winter operation, the crankcase should be drained regularly every 500 miles.

The new car, fresh from the shop, is likely to be somewhat clogged with metal chips and even sand from the castings, while it is almost certain that the rapid wear engendered by the first 500 miles of service will contaminate the oil with a large amount of metallic sediment. After the preliminary run-in period the rate of wear is considerably retarded.

For summer operation, therefore, with the car in service, it is sufficient to drain at 1000-mile periods. During winter operation, however, the cooler crankcase and less effective carburetion bring about more rapid dilution of the oil with fuel. This must be guarded against. Also winter operation entails greater precipitation of moisture in the cool crankcase which induces rust when the oil is so thin that it will no longer "stay put" and protect the bright surfaces. For these reasons, it is desirable to drain twice as frequently during winter as during summer.

The crankcase should be drained while the engine is warm, say, immediately after a run, so that the oil will be thoroughly agitated and will also be thinned considerably by the heat of operation. In this condition, it is best adapted to carry off the accumulation of sediment.

It is not desirable, and in some cases it is hazardous, to flush the crankcase with kerosene; this, for the reason that there are troughs and wells in most engines which cannot be drained simply by the removal of the drain plug. Kerosene trapped in these pockets remains to dilute any fresh oil added, reducing its body and more particularly reducing its ability to cling and protect the surfaces.

We are not calling your attention to this matter simply because we are advertisers in the SCIENTIFIC AMERICAN, but because this is a point of very great importance in the correct operation of an automobile. You can readily see that three months is a rather indefinite and irregular time to set for draining crankcase, because some cars might run 6000 miles in three months, while another car might not run 600 miles in three months. The only dependable way in which to assure the regularity of crankcase draining is to put it on a mileage basis.

Our recommendation for draining and refilling transmission and differential housings is every 2000 miles. This also is put on a mileage basis for the sake of regularity in supplying the correct lubricant.

It is not necessary for you to take our word in this matter. Many of the prominent automobile manufacturers make a similar recommendation, that crankcases be drained every 1000 miles and transmission and differential housings every 2000 miles.

We feel that in editing articles of this nature you will be doing a real service to motorists if you keep these points in mind.

HAROLD A. HALL.

New York.

The Edison Questionaire

To the Editor of the SCIENTIFIC AMERICAN:

Your account in the November issue of the SCIENTIFIC AMERICAN of Mr. Edison's questionaire system of picking executives is very interesting.

While the complex entity "man" is considerably more than the sum of all his parts, and does not therefore yield to analysis by any arbitrary or mechanical system whatever, Mr. Edison's scheme is certainly far superior to most that have been proposed for the purpose during the past few years. I take it from his emphasis of memory, as the important quality, however, that even Mr. Edison doesn't realize the strongest point in favor of his plan, but has hit on a good plan by luck rather than otherwise.

The primary point in Mr. Edison's test is not memory at all; it is breadth of education, and consequently breadth of viewpoint. Memory comes only a poor second. Anyone who has any knowledge of psychology knows that the human mind *seeks for* and retains those things which interest it. A man with a perfect supermemory might fail utterly in Mr. Edison's test for the simple reason that he (as many people actually are) was too deeply interested in some one subject or group of subjects to read the newspapers or current literature. Yet if Mr. Edison were to give that same man a real memory test—say, to read a certain book and then tell as much as he could remember of its contents, that man might obtain a memory rating of 100.

The truth of the matter is that Mr. Edison is picking men of broad tastes and interests with possibly indifferent memories for his executives. It doesn't necessarily take a very good memory to retain facts that interest one, but it does take a catholicity of interests to be sufficiently interested to read over the ground covered by the questionaire.

And this catholicity of interests and broad education are, even more than fine memory, qualities of value in an executive. The function of an executive is to form judgments and to act on them. I believe that it needs no proof that the man of broad information, even on matters totally extraneous to the matter at hand, is far more capable of forming sound judgments, taking all things into consideration, than is he who knows only one thing and can therefore see only one phase of a matter. Broad education tends to develop the imagination, which is a very necessary factor in creative thinking and in reasoning things out to their ultimate conclusions. Memory, it is true, is important. So is self-confidence important; so also are willpower and several other qualities. But the broadly educated man is far more likely to have these qualities developed and disciplined to an even balance than is he who is not broadly educated. And for the reason that college men are far more apt to have a broad education than others, they are more apt to possess the necessary qualities to become successful executives than are non-college men. There is a certain discipline, though somewhat loose, in college life that does tend to develop the mental qualities in spite of the great mistakes made in college curricula of which Mr. Edison speaks.

The dominating position which Britain has held for so long in world affairs has had for one of its principal factors the educational system of her great universities. This system (the tutorial system) gives much attention to training the mental faculties, but very little to jamming the mind with facts. The trained mind will accumulate all the facts it needs fast enough. Without that mental training a man may become a veritable seven-day wonder as a technical shark, but he can never become a successful executive.

I hold no brief for things English. I have ten generations of American blood flowing in my veins. But I do hold a brief for anything that is essentially better than what America has; nor is my loyalty to America lessened thereby. And I would be very much tickled to see a system of training for executives introduced into America modeled on the English University system—classics and all. However much our colleges are in advance of our common school system for producing executives, they are still sadly lacking. Available executive timber has been falling further behind the demand for it every year. There are few industries that are not suffering and paying heavy penalty for having incompetents in executive positions. I speak from the standpoint of one who has been in the construction business for fifteen years or so, and who has come into contact with executives large and small in several score of businesses.

LEO G. HALL.

Downers Grove, Ill.

Energy and Work

To the Editor of the SCIENTIFIC AMERICAN:

In the September 10th issue of the SCIENTIFIC AMERICAN there is an article, "The Man-Testing Laboratory Where Expended Energy Is Measured," in which is described an apparatus for measuring the amount of energy expended in doing various tasks and the amount expended in doing these same tasks in different ways. It is expected in this way to discover the best ways of doing these various tasks.

This is one way of increasing a man's efficiency. Another way is to increase a man's effective energy for doing these tasks. Following is a statement of the way in which the problem of increasing a man's effective energy should be approached. A man's energy may be divided into three parts; the first part is that which goes toward keeping him alive and moving about, whether he does any work or not. This part has to be supplied before there is any energy available for the work a man is to do. The second part goes toward overcoming the inertia of the things that a man works with or works on. This part has to be supplied before any energy can be used effectively. For instance, in lifting a weight just so much energy has to be used in overcoming its inertia before there is any movement; 999 pounds of energy exerted in lifting a 1000-pound weight produces no more effect than if only 100 pounds was used. The third part is that which is over and above the energy it takes to live and what it takes to overcome the inertia of things. A very small amount of this third part produces wonderful effects. It is this part that should be particularly interesting to the manager of men who wants to know every possible means by which it can be increased and made available.

There are two ways in which this effective energy may be increased. The first way is to increase the entire amount of a man's energy by putting and keeping him in a first class physical condition. This means he must have plenty of good food and clothing, comfortable houses and medical attention, etc. The second way is by making a better use of the energy a man already has. Mr. Frederick W. Taylor and his associates have proved experimentally that a man should have a certain amount of rest in order to accomplish the best results in performing a piece of work. That the ratio between the time of rest and the time of being under load varies with the kind of work. Greater the load the longer the rest period should be. This law, as Mr. Taylor calls it, finds its explanation in the above. In order to make the best use of one's energy in performing a piece of work, such as lifting or moving an object it is necessary to take advantage of its momentum. That is, after it has once started to move to keep it moving. If it stops or its motion decreases there is the inertia of the object to overcome again; therefore an unnecessary loss of energy. By giving a man a rest we allow him to gather enough strength and energy to keep an object moving once it has been started. An unsteady motion always causes an unnecessary loss of energy. In many cases a slight increase of energy is all that would be necessary to prevent a great loss of energy by an object stopping or falling back. This small amount of energy so necessary in preventing a great loss of energy is supplied by keeping a man in good physical condition and allowing him the proper amount of rest. It is a business proposition; it is a question of making the most efficient use of the overhead expense, which in this case is the energy expended in merely living and the energy expended in overcoming the inertia of things.

WM. CROCKER.

Prescott, Ariz.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE WITH INHERENT STABILITY.—A. G. LEIGH, address G. H. Slight and A. G. Leigh, Casilla 269, Santiago, Chile. An object of the invention is to construct an airplane which will more nearly simulate the flight of a bird. More definitely stated, the object is to so construct the wings as to make practical the use of a very much shorter body and tail than has heretofore been accomplished, the wing structure being such that the steering devices may be located entirely in or adjacent to the wings instead of at the tail.

TRUSSED HOLLOW SPAR.—J. V. MAXWELL and J. P. SEISER, Cambridge, N. Y. The invention relates to trussed hollow bars or tubes, and more particularly to the spars of airplane wings, the object being the provision of a trussed hollow beam particularly applicable to airplane construction, although capable of use in other structures where a strong light spar capable of resisting severe bending strains is desirable.

Pertaining to Apparel

GARMENT SEAM.—W. S. FLATOW, 19 Bay 26th St., Brooklyn, N. Y. The primary object of this invention is to so construct a seam that the same may be readily ripped to provide for the disassembly of the parts which go to make up the garment. A further object is to so construct a shoulder or neck-band seam of a shirt that the front members thereof may be removed, recut and again positioned to present an unworn surface at the collar band.

BABY PANTS.—R. FALTER, 856 E. 10th St., Brooklyn, N. Y. The object of the invention is to provide baby pants or diaper covers arranged to be made from a single piece of material, and to permit convenient adjustment at the waist, sides and legs to properly fit the garment to the baby's body and to compensate for increase in size due to the baby's growth. A further object is to dispense with hooks, buttons or similar protruding fastening devices, by using lacing strings.

CLASP.—S. L. GEDNEY, 33 Clinton Ave., Maplewood, N. J. This invention relates more particularly to clasps for garters and other garment supporters, an object being to provide a clasp which will operate to securely hold or engage, whether there is any tension or not, a stocking or other garment, and which will permit a quick engagement and release as occasion may require.

CORSET.—S. J. NEWMAN, 43 Oak St., New Haven, Conn. An object in view is to provide a construction at the rear of the corset wherein means are presented which will cause the corset to more exactly conform to the shape of the person wearing the same. A further object is to provide a corset in which the lower portion of rear section is so constructed as to cup when placed in position.

CLASP FOR CORSETS.—S. J. NEWMAN, 43 Oak St., New Haven, Conn. This invention has for its object to provide a special form of hook to answer the unusual requirements found in some corsets. Another object in view is to provide a hook which will not only freely receive the lacing cord, but will in a certain sense clamp the same against longitudinal movement.

Chemical Processes

PROCESS FOR THE TREATMENT OF UNDECOMPOSED FERTILIZING SUBSTANCES.—D. LO MONACO, via Depretis No. 92, Rome, Italy. This process has for its object to provide a suitable cylindrical casing for treating the incompletely decomposed fertilizers, and agitating the substances and subjecting them while being agitated to the action of halogen gases, whereby the substances are wholly decomposed and made ready for immediate use.

MANUFACTURE OF ACTIVATED PANCREATIN AND STABILIZATION OF SAME.—DORA E. NEUN, 13 Laight St., New York, N. Y. The invention relates to means for preserving the amylolytic digestive power of activated pancreatin. An object is to add a substance to the pancreatin activated with sodium chloride, which will so stabilize or preserve the amylolytic power of such a mixture that it may be taken into the human system without causing harmful results. The composition consists of approximately 7.5 to 10 per cent di-sodium phosphate, 10 to 13.5 per cent sodium chloride and the balance of pancreatin, all the ingredients being moisture-free.

Electrical Devices

ELECTRIC LIGHT ATTACHMENT FOR HAND COVERINGS.—F. HODOUS, c/o Concord Lexington Apartments, 69 So. 11th St., Minneapolis, Minn. This invention has for its object to provide an electric lighting device for hand coverings, and which is adapted to be incorporated in the structure of a glove or the like to provide an illumination wherever desired. It is adapted to produce a constant or intermittent light, furnished from a small source, the illumination requisite to carry out reading, writing, signaling or similar operations in the dark. The device is simple, durable and inexpensive to manufacture.

ELECTRIC WIRE SWIVEL COUPLING AND LOCK.—T. L. DENNIS, address Geo. F. Parker, 119 West 42d Street, New York, N. Y. This inventor has been granted two patents of a similar nature, they relate to swivel couplings for electric wires, the arrangement being such that the current will pass freely. An object is to provide a coupler which may be inserted in a pair of electric conducting wires or in a plurality of wires at any point and not disturb the continuous conduit, while permitting free independent rotary movement of either section of wire. A further object is to provide means whereby the plugs or connecting pins may be easily inserted, but are locked against accidental removal.

PORTABLE LAMP.—G. F. BASON, 169 Woodruff Ave., Brooklyn, N. Y. One of the objects of this invention is to provide an electric lamp which is adapted for general use, and which may be secured to the back of the hand of an operator of motor vehicles to be used for signal purposes, or may also be used as a trouble light, an inside light, or parking light; and to this end a suitable bracket is provided to support the lamp at various points.

PORTABLE ADJUSTABLE HOLDER FOR FLASHLIGHTS. — E. G. QUARNSTROM, 5419 Agatite Ave., Chicago, Ill. An object of the invention is to provide a holder for a flashlight that is readily portable and provided with adjustable means whereby the device can be mounted upon a hat, coat or other article of apparel of the operator, and the light from the flashlight directed as desired without its being necessary to hold the device in the hand.

FLASHLIGHT.—J. VINCE, 429 78th St., Brooklyn, N. Y. An object of the invention is to provide a conductor element so related to the shell and to the battery that it may be operated from the exterior of the shell and close the circuit and at the same time minimize the possibility of the battery "freezing" to the shell and makes provision for the ready removal of the battery and conductor strip without damage even should the battery "freeze" by long disuse.

ELECTRIC FIXTURE.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. An object of the invention is to provide in an electric fixture an insulated stem adapted to insulate a lighting fixture that depends therefrom from a fixed support without its being necessary to provide the usual insulating joint. A further object is to provide a device which is simple in construction, ornamental in appearance, effective in use, and may be readily manufactured at a small cost.

ELECTRIC HEATER.—O. P. SCOTT, c/o Scott Electric Manufacturing Co., Tacoma, Wash. The invention relates to heaters adapted for the heating of air or water, and a purpose is the provision of an electric heater of simple and substantial construction, wherein the elements comprised in the heater are exposed to facilitate the repairing thereof. It is also a purpose to provide an electric heater which consumes a minimum quantity of current.

Of Interest to Farmers

ARRANGEMENT FOR SEPARATORS WITH HANGING BOWLS.—F. MORTENSEN, Helsingfors, Finland. This invention relates to a separator of the type having a suction fan for drawing milk, and having an aperture through which cream is driven due to the separating action of centrifugal force, and characterized by having an outlet at one side of the suction fan through which milk may be driven under centrifugal force to overcome the suction action which tends to draw the milk into the suction fan.

AGRICULTURAL IMPLEMENT.—L. A. GREEN, c/o American Cotton Grader Company, Greenville, S. C. The invention has for its object to provide an implement wherein a supporting frame and rotatable mounted tool supports are made use of, together with a motor for driving the device, the supports being arranged in series and connected to the motor in such manner that they are driven in opposite directions, enabling an extremely light motor to equalize the strong propellers and regulate the speed, and wherein the cultivating mechanism cuts the soil backward to force the light frame forward.

FARM GATE LATCH.—H. H. and G. H. BERG, Thornburg, Col. This invention relates to gate latches in general and more particularly to latches for farm gates, the purpose being the provision of a gate latch of extremely simple and efficient construction which is operable to automatically latch a gate when the same is swung to closed position.

CLAMP.—H. R. MOKLER, c/o Tolma Deyo Co., Tolma, Ill. The object of the invention is to provide a device especially designed for holding objects, of irregular form, to be ground or polished, such as plowshares, cultivator shovels, harrow-blades, planter knives, and the like, wherein there is provided a body member having a pair of fixed stops or abutments spaced apart and having a clamp movable between the abutments.

LAND LEVELER.—O. W. BEACH, Box 361, Turlock, Calif. Two patents have been granted to this inventor on similar subjects, they relate particularly to a machine which is adapted to be towed by a tractor or the like for leveling ground surfaces of agricultural lands, roadways, and like surfaces. The primary object is to provide a machine equipped with a scoop which is capable of assuming various scooping positions relative to the ground and dumping its load gradually over the surface to be leveled. Means are provided for automatically disconnecting the scoop from the means employed to move the same, means are also provided for carrying the loaded scoop to a distance, and effecting its unloading at a desired spot.

SUBSOILER.—J. F. BELKNAP, P. O. Box 81, Orange Cove, Calif. The invention relates to subsoilers or harrows, and has reference more particularly to a tooth or blade for such implement. A specific object is to provide a tooth for use in subsoiling or breaking up hardpan earth which will be rugged in construction, yet light in weight, and unusually durable regardless of the hardened condition of the soil surface on which it is to be used.

Of General Interest

KEY CASE HOLDER.—D. I. REITER, 127 University Place, New York, N. Y. The object of the invention is to provide a holder which can be made and stamped from a single piece of sheet metal and bent and formed into shape ready for the application of key latches thereto in a simple and economical manner. Such extra attachments as pins, or other similar devices, are unnecessary to hold the key links in position on the plate.

HORN.—J. LEVY, 2161 67th St., Brooklyn, N. Y. The invention particularly relates to a sound-producing horn for amusement purposes, and has for an object to provide a simple but strong construction which will not easily get out of order. Another object is to provide a vibrating tongue or mouthpiece, held in place by ears bent from the body of the horn instead of solder or other holding means.

SHOELACE TIP.—H. D. CHAFFEE, 6 Pearl St., South Manchester, Conn. The primary object of the invention is to provide a conical-shaped tip of the above character which is adapted to be quickly and easily attached to the end of a shoelace or the like, the tip being so constructed that it will not become detached from the lace during the use thereof.

TAG.—C. I. MINKOFF, c/o Stout Dress Co., 48 West 25th St., New York, N. Y. The invention aims to provide a device which is adapted to be associated with a garment while the same is upon the hanger, so that the dress will present a neat and slender appearance even while in this position. A still further object is the construction of a device of this character which may be manufactured at a nominal figure, and which also will act as a price tag, size tag, etc.

PROCESS OF LETTERING.—A. N. SANDT, Red Wing, Minn. An object of the invention is to so proportion the letters on a curved or receding surface that the words formed by the letters will have the same appearance as if the surface were a flat one. The invention more particularly relates to the process of lettering labels for cans, bottles, or other cylindrical, angular or receding surfaces.

FAN.—R. I. FAUCETT, c/o Methodist Episcopal Church Mission, Muzaggarpore, Bihar, India. The invention has for its object to provide a fan especially adapted for use in connection with swings, as, for instance, porch swings, for creating a cooling current of air toward the occupants of the swing, and controlled by the swinging of the swing.

OPTICAL TESTING APPARATUS.—J. A. BELL, Box 461, Bremerton, Wash. The object of the invention is to provide an optical testing apparatus, embodied in a cabinet, in which the requisite test charts are presented directly in a patient's line of vision, within a well-lighted aperture or window and which displays but one chart at a time so as not to confuse the patient by requiring him to look at various charts simultaneously displayed.

PRICE CARD HOLDER.—C. E. OSBORN, c/o Thuenen & Thuenen, 23 Davenport Savings Bank Bldg., Davenport, Iowa. Among the objects of the invention is to provide a

THE object of this department is to catalog recently patented inventions and design patents for ready reference. In view of the large number of patents covered, it is obvious that each notice must be confined to the broad essentials of the patent described and, in some instances, illustrated. The name and address of the inventor are given in every instance, to facilitate direct correspondence. Copies of the patent specification will be furnished upon receipt of 15 cents each. In a word, this is to be a meeting place for the man with an idea and the business man in search of an idea.

card holder of simple construction which may be secured to cans, boxes, or the like, in which different commodities are retailed from grocery stores, or the like, for displaying a card having written thereon the price at which the commodity is to be sold.

BUCKLE.—J. G. FISHER, 219 E. Capitol St., Washington, D. C. An object of the invention is the provision of a buckle which is for the most part formed of a single piece of metal, and which embodies a buckle retainer for permanently preventing lateral or horizontal as well as vertical displacement of the buckle while in no way detracting from the clasping action of the buckle or from its features of comfort or attractiveness.

RAT TRAP.—R. F. KENT, Hotel Montgomery, Chambersburg, Pa. A purpose of the invention is to provide a rat trap having a runway in which is removably fitted a cage, and spring actuated means controllable by a platform located in the runway for forcing the rat into the cage when the rat occupies the platform, and for automatically closing the cage so as to confine the animal therein, such means being operable to reset itself after each actuation. (See Fig. 1.)

FOUNTAIN PEN.—N. B. PANOFF, 54 E. Seventh St., Brooklyn, N. Y. Among the objects of the invention is to so construct a fountain pen that when the pen is in closed position, the ink reservoir is contracted at its discharge end to prevent feeding of the ink regardless of the position of the pen. A further object is to so construct the pen that when the cap is removed from the rear end thereof the ink remaining upon the nib will be drawn into the reservoir, the operating mechanism being included in the closing cap of the pen.

RING SETTING.—R. ROSENTHAL, 15 John St., New York, N. Y. This invention relates to jewelry and has for its object to provide a construction wherein the stone or jewel may be readily secured in place without danger of injuring the same. A further object is to provide a ring setting in which a mat is provided for a stone and a clamping ring is threaded thereto, the ring being provided with an edge over which the retaining prongs may be bent.

SHOE TREE.—G. A. BRADY, 2008 Green St., Philadelphia, Pa. The general object of the invention is to provide a shoe tree having means whereby the tree will automatically adjust itself to conform to the lines of the shoe and will preserve the normal shape and form of the shoe without stretching or distorting it in any way. The device, being simple in construction, will permit of manufacture at a low cost. (See Fig. 2.)

DISPLAY STAND.—N. RIPPENBEIN, 235 West 71st St., New York, N. Y. This invention relates particularly to that form of display stand commonly used in retail stores to display small packages of candy and similar articles. An object is to provide a stand which will serve to display four sides of rectangular articles placed thereon, and which is provided with numerous surfaces for the display of advertising matter.

ADJUSTABLE BLACKBOARD T-SQUARE.—M. L. CURTS, 711 East 10th St., Bloomington, Ind. The object of this invention is to provide a T-square having an adjustable supporting arm for lengthwise adjustment constructed in a simple manner for mounting the same upon a blackboard and provided with a blade, whereby drawings may be executed with facility, and particularly for instruction purposes, the T-square being adapted for use in cooperation with triangles, as in the ordinary use of a T-square.

NUT-CRACKING DEVICE. — G. A. PUEPPKE, address R. L. Clark, Oshkosh, Wis. Among the objects of the invention is to provide a device of this character which is adapted for use in cracking pecans or other nuts of a similar nature. An important object is that the nutcracker be adapted to crack the pecan or similar nut in such manner that the meat may be removed in an unbroken state.

SIGNALING DEVICE.—W. V. BERGEN, c/o Shute Savings Bank, Hillsboro, Oregon. The invention has for its object to provide a device adapted to be arranged along highways for indicating danger or the need for caution, wherein a visual signal is provided capable of being seen in daylight, and having means for illuminating the same through the reflection of the headlights of an oncoming car to be visible at night.

GARBAGE CAN.—I. LEVY, c/o Nechthouse & Levy; Java, Provost & Kent Sts., Brooklyn, N. Y. The principal object of the invention is to construct a garbage receptacle for household use in which there is an inner and an outer receptacle movably arranged together in such manner that the inner receptacle may be readily removable from the outer. A further object is to so construct the parts that they will have interengagement and to prevent movement of the inner receptacle when desired a single cover serving for both.

LAUNDRY FORM..— F. E. O'BRIEN, 2330 6th Ave., Troy, N. Y. This invention has reference more particularly to a form used for the starching and drying of collars worn by sisters of religious orders. An object is to provide a device for the finishing of collars which will eliminate ironing of the collars and give the collar a dull finish.

POLISHING BRUSH.—C. H. ANDERSON, c/o Hughes Bozarth Anderson Co., 15-21 East Grand Ave., Oklahoma City, Okla. This invention relates more particularly to shoe brushes, the object being the provision of a strong, durable brush of this nature which may be readily carried from place to place, occupies but small storage space, is practically indestructible, may be readily cleaned from time to time and is capable of effective use without danger of soiling or injuring the hands.

HELMET OR MASK.—F. M. BOWERS, 3000 West 9th St., Chester, Pa. Among the objects of this invention is to so construct a headgear for masks that the latter may be adjusted with respect to the head of the wearer in order that it may be used to support masks upon heads of various contour. A still further object is to provide a lens-holding device in masks of this character.

AUTOMATIC RIFLE.—I. W. WAGNON, Casa Grande, Ariz. This invention has for its object the provision of a rifle of the character specified, magazine-fed, recoil-operated and air-cooled, wherein the motive power for the operation of the mechanism is furnished by the recoil of the bolt incident to the explosion, and wherein recoil springs are eliminated.

ARTIFICIAL BAIT.—J. FRAME, c/o Penobscot Coal Co., Searsport, Maine. The general object of the invention is to provide an artificial bait with means for giving motions more or less in simulation of the natural motions of a minnow by flexing the articulated tail portion, and by novel fins to cause the bait to turn to one side and rise toward the surface, and to the opposite side and produce a diving action. The hooks have flexible guards concealing them, but yielding to the attack of a fish. Fish oil may be caused to exude from the bait through its tail and sides as a lure.

DISH SCRAPER.—F. BEUCKMANN, 534 No. 22d St., East St. Louis, Ill. An important object of the invention is to provide a cleaning device having a scraping head of rubber or other flexible material capable of bending slightly so that the same may be employed for cleaning the sides and bottoms of cooking utensils and dishes. The device is especially applicable for use in candy shops, bakeries, laboratories, etc. The exterior of the scraping blade is smooth and may be easily cleaned by being drawn over the edge of a refuse pail. (See Fig. 3.)

GATE VALVE.—M. C. CHRISTENSEN, c/o R. F. Radebaugh, 1801 South 60th St., Tacoma, Wash. The invention relates to valves used for drawing off the contents of molasses barrels and the like. An object is to provide a gate valve with automatic locking means which will operate to lock the valve in closed position so that accidental opening thereof will be prevented, the locking means being so constructed that it will snap into place the instant the valve is closed.

APPARATUS FOR SUPPLYING AIR TO THE EXTERIOR OF HULLS OF SHIPS.—F. G. TRASK, Ross, N. D. Among the objects of the invention is to supply air to the exterior surface of the hull of a ship, beneath the level of the water whereby the speed of the ship may be greatly increased. An important object is to provide apparatus which is adapted to supply a sheet of compressed air to the exterior hull of a ship, in contact therewith, and which apparatus is adjustable to vary the thickness of the sheet of air.

SORTING RACK.—T. HAWKINS, 440 Hanover St., Derry, N. H. Among the objects of the invention is to provide a sorting rack for letters which will expedite the work of mail carriers in arranging letters for their respective routes. A further object is to provide a rack of the character described which will be simple and practical in construction and strong and durable in use.

ARTIFICIAL SILK.—R. D. LANCE, 18 Rue Saint-Claude, Livry, France. The invention has for its object the production of artificial viscose and nitrocellulose silks of great strength and from which fabrics that can even be washed in boiling water can be made. In accordance with the present invention such a silk is obtained by adding metallic resinates to cellulose esters such as a solution of viscose or of nitrocellulose and then spinning the mixture.

SAMPLE CARD.— E. HIRTZ, 5 Rue d'Alexandrie, Paris, France. The invention relates to a sample card for fabrics, silk goods, wallpapers, and the like, by means of which it is possible to display, take off and replace at will the samples, and bring the same together. The cards are so arranged that the samples may be quickly changed. These sample cards are not cumbersome or bulky and can be used indefinitely.

LOCK.—J. L. YATES, 1257 Washington Ave., Bronx, N. Y. Among the objects of the invention is to provide a combination catch and bolt lock apparatus having means on the inside of the door for manipulating either the catch or the bolt without the key, but having means within the lock whereby the catch and the bolt are movable independently of each other by the key in different positions.

FRAME FOR PRINTERS' FORMS.—L. G. GARBE, 662 Clayton St., San Francisco, Cal. Among the objects of the invention is to provide a method of binding printers' forms which consists in the use of a plurality of frame members having registering tongues and grooves at either end, and being adapted to be interchangeably locked into rectangular frames of various sizes, and of set-screws for yieldingly securing the frame members to one another.

COOKING DEVICE.—KATE A. WEISGARBER, Vibank, Saskatchewan, Canada. The invention relates to a device for use in making cookies and has for its object to produce a device so constructed that it may be heated by plunging it into hot fat, and may be dipped into the paste for picking up the desired quantity, and the article to be quickly cooked by again plunging the device with the paste thereon into the hot fat. A further object is to so form the device that the cooked article may be ejected.

VALVE.—M. BLUM, 504 Myrtle Ave., Monrovia, Cal. An object of the invention is to provide an outlet valve for steam radiators which will allow the escape of air but will automatically close when steam starts to escape therefrom. A further object is to provide a valve in which the moisture and heat of the steam act upon an expanding member to close the outlet passage after the air has escaped.

Hardware and Tools

WRENCH.—B. G. PATTERSON, 1111 W. 15th St., Oklahoma City, Okla. The invention has for its object to provide a wrench which is quickly adjustable to operate upon various objects, which is self-locking, which may be readily released with the thumb of one hand, and which is of simple and durable construction, reliable, and inexpensive to manufacture.

CORNER LOCK.—W. J. MARVIN, 648 Monroe St., Brooklyn, N. Y. The invention aims to provide a device adapted for use in connection with bedsteads, an object being to provide a corner lock serving to effectually support the cross and side angles in such a manner that no play can come into being between the various parts of the bed. The device is capable of association with any type of bed.

WRENCH.—C. A. MCILVAINE, Balboa Heights, Canal Zone, Panama. An object is to provide means for moving the movable jaw of the wrench so as to effectually grip a nut or permit a release of the same after the initial adjustment is made. A further object is to provide an arrangement of thumb or finger lever which operates as a cam to impart movement to the movable jaw and which may be in its extreme position to lock the jaws or the nut.

FASTENING HINGE.—J. A. BRADY, 1027 Park Ave., Hoboken, N. J. The invention relates to a fastening hinge for use in combination with a display stand, which comprises panels, and risers and treads supported by the panels, means adapted to movably connect the risers and treads with each other, and further means adapted to engage the panels supporting the risers and treads for rigidly connecting these elements together.

SAFETY RAZOR.— W. NOWAK, 1797 Clinton St., Buffalo, N. Y. This invention particularly relates to that type of safety razor employing double-edged blades clamped upon the outer convex face of a guard plate and between this guard plate and the clamping plate. The object is to provide a construction whereby the clamping plate may be secured in connection with the guard plate in

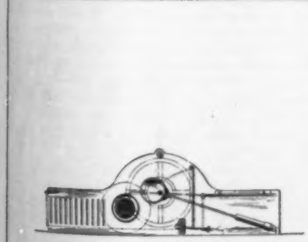


Fig. 1. Rat trap that will catch a second rat while the first is still in it; patented by R. F. Kent

Fig. 2. G. A. Brady's automatically adjusting shoe-tree, which conforms to the shape of the shoe

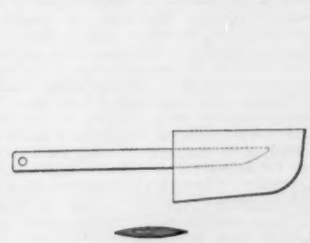


Fig. 3. Scraper with flexible head, for cleaning pots, pans and dishes, put out by F. Beuckmann

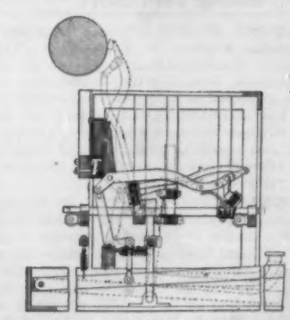


Fig. 4. The ribbonless typewriter invented by E. Winterer. (See page 280 for description)

such a manner as to permit of its ready association therewith and disassociation therefrom.

HACKSAW.—M. C. GIBSON, 427 East 84th St., Los Angeles, Cal. An object of the invention is to provide an adjustable frame hacksaw that may be used with any usable length of saw blade. A further object is to provide a structure in which any portion of a broken saw blade may be used without any preparation to the ends of the pieces, or providing the same with connecting means.

TEMPER SCREW FOR WELL-DRILLING TOOLS.—R. E. NEILSON, 417 East 1st St., Tulsa, Okla. One of the foremost objects of the invention is to construct a temper screw so as to render the tool far more durable than ordinary temper screws, many of the parts being interchangeable and quickly replaceable, so that repairs can be rapidly made. A further object is to provide reversible and interchangeable reins, in which the head and jaw extensions to which the reins are secured are themselves replaceable in cases of breakage.

EXTENSION BIT.—P. BASMAISON, 1234 Diamond St., San Francisco, Calif. The invention has for its object the provision of means for increasing the strength of the bit and so reinforcing the cutters that the bit will not stick even if the brace is not held steady. Another object is to provide ample clearance for the shavings, and this clearance may be easily adjusted and held very close to the center of the tool. Further objects are to provide a clamp adapted to hold bits of various thicknesses, and to provide a bit which may be easily sharpened.

COMBINED GAGE.—E. G. MORIN, JR., 4004 20th St., San Francisco, Calif. The invention relates to a sheet metal gage which is especially adapted for use by carpenters, joiners and like workers in the marking of striking plate, lock, hinge mortise and other similar cuts on doors, door jamb rabbets and similar structures. The primary object is to provide a simply constructed, easily adjusted gage which may be used for making various markings without necessitating readjustment for each different marking.

PLANE.—E. J. SWEENEY, 707 S. Winnebago St., Rockford, Ill. Among the objects of this invention is to provide a practical form of adjusting means for the bit of the plane which will serve to regulate the depth of cutting of the plane and to adjust the bit for wear, the invention embodying structural features which also tend to add strength to the tool.

COMBINATION LOCK.—F. CLARK, 6 Calle de Juarez 82, Durango City, Mexico. Among the objects of the invention is to provide a combination or permutation lock of simple and compact construction in which a plurality of tumbler members adapted to be actuated by a key are provided with a means which may be readily adjusted to determine the movement of the tumblers to permit the movement of a bolt control member. A further object is to provide a key construction having a body core portion and a means rotatably mounted thereon for receiving longitudinally adjustable ward members.

LOCK.—C. LIBERMAN, 1732 Madison Ave., New York, N. Y. The object of the invention is to provide a lock more especially designed for use on doors and arranged to lock the door securely to prevent opening by unauthorized persons. Another object is to prevent retraction of the bolt by the insertion and manipulation of thin-bladed tools or other implements.

Heating and Lighting

HEATING STOVE.—C. A. BURRIDGE, c/o Burridge Studios, St. John, Mich. The purpose of this invention is to produce a heating stove formed with a plurality of flues so arranged as to provide a circulation of air both interiorly and exteriorly of the stove and from different strata of air whereby full and complete radiation and circulation is effected and the heating of all strata of air within the room.

FIRE-KINDLING DEVICE.—F. LYNES, Johnstown, N. Y. Among the objects is to provide a device which in its entirety is an article of manufacture and in which all of the several parts are formed from combustible material capable of complete consumption in the presence of fire. The device is so constructed that it is capable of use in the firebox of any of the ordinary types of stoves, furnaces or house-heating boilers.

Machines and Mechanical Devices

TYPEWRITER.—E. WINTERER, 320 Wilcox Bldg., Los Angeles, Calif. The invention while relating to typewriting machines in general, has reference more particularly to ribbonless typewriters. The primary object is to provide a comparatively simple construction in ribbonless typewriters and particularly a construction in which a cooperative relationship of parts is so arranged as to provide a most efficient operation in such machines. (See Fig. 4, page 279.)

WATER RIGGING FOR STOPPING DRILLS.—W. H. JOYCE, 301 E. 5th St., Leadville, Colo. This invention relates more particularly to mining drills, for instance, coal drills where the rapid accumulation of dust has a tendency to clog the action of the drill. An object is to provide a simple and convenient water rigging, by means of which a stream of water may be injected directly against the bit in action, and a further object is the provision of a water rigging which may be readily adapted to a stopping drill.

OIL CUP.—W. H. LINDENFIELD, 320 No. Clifton St., Lexington, Tenn. The invention has for its object to provide mechanism in connection with oil cups of the Hancock inspirator type for preventing accidental displacement of cover and feed valve, due to jars from the machinery upon which the cup is used. A further object is to provide mechanism in connection with the valve stem for locking the stem to permit the feed to be regulated.

SAND SETTLER.—I. A. KARNS, c/o New Oklahoma Hotel, Tulsa, Okla. The object is to provide a settler which may be easily attached to the working barrel of a deep well pump, and adapted to cause any sand which may be carried into the settler with the oil, water or other liquid being pumped from the well, to be entirely settled or precipitated from the oil or water before the same passes into the working barrel of the pump.

HEADLOCK FOR PRESSES.—E. C. RUDOLL, 304 Hatten Ave., Rice Lake, Wis. This invention relates more particularly to head blocks adapted for use in connection with excelsior or hay presses. An object being to provide a construction of head block providing grooves for the accommodation of bale-tying wires and which is so constructed as to efficiently house the wire and yet permit the removal of same as occasion may require.

PUMP.—H. S. TOOKER, The James Boiler & Machinery Co., Joplin, Mo. An important object is to provide a pump having means whereby the same may be operated at a point remote from the same so that a pump operating apparatus in the form of a steam engine or the like need not be installed with the pump. A further object is to provide a pump which may be operated on the surface of the water, or submerged, or arranged in a variety of positions, or suspended in midair as when hanging in a mine shaft.

MORTISING MACHINE—W. T. S. PATE, 711 Bates St., Indianapolis, Ind. One of the foremost objects of the invention is to provide a machine for cutting the bolt slot and rebate in objects such as furniture drawers and the like. A further object is to provide a machine by means of which an elongated cavity may be bored with a surrounding relatively shallow depression or rebate, the idea being to provide a place into which either a block or guard plate may be set.

CHENILLE UNTWISTING AND WINDING MACHINE.—G. C. L. TISCH, 454 Spring St., Elizabeth, N. J. Among the objects is to provide a machine timed to operate in proper step with the machine which forms the chenille so that it may produce an automatic untwisting action as fast as the chenille is manufactured. The untwisting mechanism is comparatively small, and consequently requires but little space to properly untwist great lengths of chenille. A still further object is to provide a machine for winding the untwisted chenille on a drum ready for disposal in any desired manner.

METER FOR MEASURING GRANULAR MATERIALS.—E. OGUR, 34 Park Ave., East Orange, N. J. The invention has reference more particularly to a meter provided with a discharge screw whose rotation is automatically stopped when no more material is supplied to the meter. An object is to provide a meter which will continuously discharge granular material therefrom and register the amount of the material discharged.

ESCAPEMENT FOR TIMEPIECE.—I. GREENWALD, 236 West 113th St., New York, N. Y. The object of the invention is to provide a construction in which the usual hair spring is eliminated and a coil spring substituted. Another object is to provide an escapement in which a coil spring is utilized together with a system of gearing whereby the balance wheel may be caused to travel less or more than one revolution upon each of its back and forth movements.

POWER TRANSMITTING DEVICE.—W. J. FRANCKE, Highland Park, N. J. This invention has for its object to provide a transmitting device more especially designed for transmitting power by angularly disposed shafts. Another object is to compensate for the non-circular path and the irregular angular advance of one coupling member relative to the other, to insure a continuous driving of the driven transmission shaft from a uniformly driven driving or motor shaft.

PISTON RING.—T. G. SAXTON, c/o Yale Piston Ring Co., Boonton, N. J. The invention aims to provide a two-part piston ring in which the inner part of the ring is formed of a highly expansible material, and such inner part is encircled by an outer ring of less expansible material. The two parts of the ring cooperate with one another to automatically expand to the limits of the groove in a direction parallel to the longitudinal axis of the piston.

PUMP.—J. R. TINNEY, 507 N. Ninth Ave., Phoenix, Ariz. Among the objects of the invention is to provide a rotary pump in which the elements are so constructed and arranged that the pump may be securely though detachably suspended in the well and will deliver a volume of fluid limited only by the cross section of the well casing, all surging and whirling being eliminated, thereby attaining the maximum output with minimum construction of power.

FRUIT SIZING APPARATUS.—F. J. PEARSON, R.F.D. No. 5, Box 78, Troy, Ohio. The primary object is the provision of a construction which provides for more effective sizing and avoids the danger of inaccurate grading as well as one which in certain other respects provides for effective cooperation of the parts in the automatic feeding of fruit to the sizing members so that the feed is uniform and also without danger of injury to the articles being fed.

PUMP.—F. ROBERTS, Eliasville, Texas. This invention has for its object to provide a pump especially adapted for use with oil wells, for pumping oil, wherein the pump has a double barrel and a double plunger, together with valves arranged to permit the plungers to function simultaneously to lift the oil.

EMBOSSING DEVICE.—V. E. BAKER, 418 E. Broad St., Elyria, Ohio. An object of this invention is to provide an embossing device that embosses and cuts off a thin strip of metal during part of its operation and automatically feeds another portion of the strip to be embossed during another part of its operation. The device is simple in construction and thoroughly efficient in operation.

TICKET PRINTING DEVICE.—N. BONGOM, Lake Mills, Iowa. Among the objects of the invention is to provide a device having a plurality of relatively movable type-holding disks which can be arranged to permit the printing of various values on a ticket strip, so that the portions of the ticket strip successively printed can be torn off when printed and used as desired.

SHOE LAST REMODELING MACHINE.—O. OLSON, 129 Clemont Ave., Brooklyn, N. Y. The invention relates to a machine for the remodeling of old lasts. An object being to provide a machine which will remodel a plurality of lasts in exact conformity with a pattern last and perform the work with a minimum of labor so that shoe lasts can be quickly, cheaply and accurately remodeled.

CORNER CUTTING GAGE FOR PAPER CUTTING MACHINES.—V. T. RYBICKI and B. GREENFIELD, address V. T. Rybicki, 1194 Brook Ave., Bronx, New York. The primary object of the invention is to provide a simple and inexpensive gage in the nature of an attachment for a flat paper cutting machine which is adapted to be associated with the back gage and which is universally adjustable with respect thereto for accurately positioning and retaining a stack of paper relative to the knife.

WASHING MACHINE.—H. METHOT, Red Bank, N. J. Among the objects of the invention is to produce a power washing machine of the reciprocating plunger type in which the articles washed are subjected to varying amounts of pressure. It is a further object to provide a pivoted platform for supporting the driving mechanism of the plungers in such manner that the plungers and their reciprocating means may not be subjected to undue strain.

AUTOMATIC DUPLICATING MACHINE.—T. A. STEINMETZ, address A. B. Shoemaker, Eau Claire, Wis. The invention relates to a machine in which duplication will be effected, and which may be relied upon to be an accurate reproduction of the pattern. An object is the construction of a machine which shall be entirely automatic aside from starting and stopping the same, so that defects incident to the human equation are eliminated.

GEARING DRIVING UNIT.—F. J. and J. L. MUENCH, General Machine Co., 306 Market St., Newark, N. J. The invention has particular reference to gear driving units for chemical agitators. Among the objects is to provide a unit in which certain parts may be readily removed for repair and replacement without dismantling the entire apparatus, and whereby the driving and driven shafts are so arranged that a plurality of units may be readily connected together and driven from a common source of power.

CENTRIFUGAL CASTING MACHINE.—C. F. BLOOM, Box 96, Bend, Oregon. The foremost object of the invention is to provide a preferably hand-operated casting machine for dental purposes, wherein the flask or mold containing the molten metal is first elevated in the vertical part of a subsequently semicircular track, being gradually thrown outwardly along a spiral line until it reaches the end of said track, where it is spun in a circle so as to force the metal into the crevices by virtue of the centrifugal action.

COLOR SORTING MACHINE.—P. F. DUSHA and A. FEYK, 1797 1st Ave., New York, N. Y. The invention has particular reference to a machine for sorting buttons. An object is to provide a machine in which the buttons are fed and presented successively to operators with the sides of the buttons reversed so that the operators can examine both sides of the buttons without any manual aid, to sort them if the color or other characteristics are not what is desired.

CANE SUGAR MILL.—J. MEINECKE, Paia Mani, Territory of Hawaii. The invention has for its object to provide a cane chute by which the bagasse may be properly pushed or conveyed from one mill to the other without injury or distortion from pressure, as well as obviating the necessity of employing a conveyor of the slatted or belt type and eliminating the large number of complicated parts employed in the chain type of conveyor, thereby reducing the cost of construction as well as maintenance and upkeep.

Medical Devices

ORTHOPEDIC APPLIANCE.—L. S. DOYLE, 409 East 6th St., Austin, Texas. The object of the invention is to provide an appliance which is adapted to exert a pressure upon the spinal column in the lumbar region so as to maintain the vertebræ in proper position and relation, thereby relieving the associated organs and muscles of abnormal strains and restore these portions of the body to normal position and condition.

Musical Devices

AUTOMATIC PHONOGRAPH STOP.—C. H. TAYLOR, Crosby, Minn. An object of the invention is to provide a stop for a phonograph or like sound producing machine which is adapted to be automatically operated to stop the rotation of the turntable when the direction of movement of the tone arm of the machine to which the stop is applied has been reversed. A further object is to provide a device that normally prevents rotation of the turntable when the tone arm is out of operating position.

PNEUMATIC ACTION UNIT.—S. BARTNER, 100 Eagle St., Brooklyn, N. Y. This invention relates to pneumatic actions such as are commonly used in connection with player pianos, organs, and like instruments. Among the objects is to provide facilities for utilizing independently manipulated pneumatic units whereby any of the units may be easily reached for inspection, repair, interchange or the like, at any time and without disturbing any other of the units.

MUSIC HOLDER FOR BAND USE.—T. P. HORGER, JR., Livingston, S. C. The invention relates to holders especially

Fig. 5. Cut-off relief and automatic-control air-brake valve, by E. P. Clauss

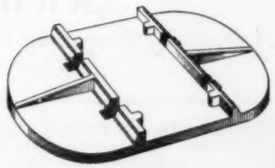


Fig. 6. Rail chair designed by A. Vanzile to avoid creeping, running and spreading

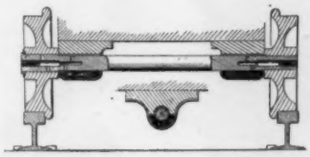


Fig. 7. Running gear that promotes easy lubrication, patented by R. D. Scott and J. G. Cadwell

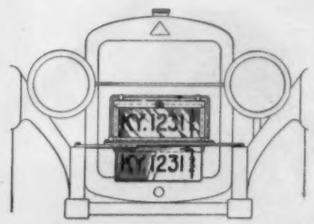


Fig. 8. C. W. Zint's invention for preventing the unauthorized driving of automobiles

adapted for instruments such as cornets, bugles, etc. An important object is to provide a sheet music holder having means whereby the several sheets of music may be automatically advanced to a position where the desired sheet may be conveniently selected and played. A further object is to provide means whereby the sheets will be protected from rain.

BRUSH FOR TALKING MACHINE RECORDS.—J. F. and W. BORST, 1117 Cypress Ave., Ridgewood, Brooklyn, N. Y. The present invention pertains more particularly to an attachment for the sound box or reproducer thereof. An object is to provide a brush which is capable of use with sound boxes so mounted as to adapt them for playing records of both hill-and-dale and lateral types engaging the record in advance of the stylus of the sound box and in the path of the stylus in order that the grooves may be cleaned of foreign matter.

Prime Movers and Their Accessories

COOLING, CLEANSING AND FILTERING DEVICE FOR GAS.—D. J. SMITH, 40 Woodberry Grove, Finsbury Park, London, N. 4., England. The invention relates to an apparatus which is generally known as a gas scrubber, as used in connection with suction gas plants for supplying internal combustion engines. This invention is also applicable to other types of gas-producing plants, or for other gas from which it is desired to remove any matter held in suspension and also reduce the temperature of the gas to the desired degree.

VAPORIZER.—H. EPSTEIN, J. J. MITNICK and J. M. BERNSTEIN, c/o J. J. Mitnick, 1859 S. Troy St., Chicago, Ill. An object of the invention is to provide a vaporizer for internal combustion engines, having electrical heating elements so arranged that the maximum amount of heat is transmitted to the gases passing from the carburetor when the throttle valve is at or near closed position, while a minimum amount of heat is given off when the valve is wide open. A further object is to provide a device in which the heat is gradually decreased from maximum to minimum.

VAPORIZER.—H. L. BUMBAUGH, Phi Kappa Pi, Stanford University, Calif. This invention aims to provide a vaporizer which will permit of practically the instantaneous starting of the consuming element, such as an explosive motor, so that it will be only necessary to actuate the starting crank to a small extent, or if a starter is used the same will be operated for merely a proportionate amount of time to produce an explosion, thus saving the battery from damage and distortion incident to a continued operation of the starting motor.

AUTOMATIC FUEL CONTROL.—T. W. CRANE, 620 No. J St., Imperial, Cal. The object of this invention is to provide a two-tube system, wherein the fuel tank is connected to the carbureter fuel chamber by an air pipe and a fuel pipe, the arrangement being such that as fuel is withdrawn air will be admitted to the fuel tank to permit fuel to feed from the tank to the fuel chamber of the carbureter. A further important aim is to provide means wherein the vacuum tank and the pipes leading therefrom to the carbureter constitute the sole means for maintaining the fuel level, thereby dispensing with the necessity of a float and associated parts.

Railways and Their Accessories

CUT-OFF RELIEF AND AUTOMATIC CONTROL AIR BRAKE VALVE.—E. P. CLAUSS, Lyons, N. Y. An object of the invention is to provide a valve for air brake systems which will not overlap and will, therefore, either bleed the line or hold the same close and the brakes properly released. Another object in view is to provide a construction of valve which will not depart radically from the present construction, but will prevent accidents through the improper turning of any valve. (See Fig. 5.)

CAR COUPLING.—L. and F. PIGNANI, c/o Sam W. Miller, Blaireville, Pa. The invention relates to automatically operated car couplings of the link and pin type. The purpose is to provide a car coupling which is particularly, although not necessarily, adapted to use on mine cars, the coupling containing the desirable features of simplicity, durability, efficiency and constructed to make and maintain the coupling at all times and under most difficult conditions.

RAIL CHAIR.—A. VANZILE, 395 Wisconsin Ave., Long Beach, Calif. The invention has for its general object to provide a rail chair so formed that when spiked to the tie and engaging the rail it will afford resistance to the creeping or running of the rail and the spreading of the rails. Among the objects is to provide lugs to enter recesses in the rail serving to effect an interlocking engagement between the rail and the chair. (See Fig. 6.)

SAND DISTRIBUTING APPARATUS.—T. L. SWEARINGEN, Box 274, Danville, Ky. A purpose of the invention is the provision of an apparatus in which manually operable means is provided for shifting the distributing nozzles laterally with respect to a railway track so as to cause the nozzles to be at all times directly above the rail and to thereby deposit the sand on the rail irrespective of the angular position of the locomotive. Pneumatically operative means are provided for delivering the sand to the nozzles.

RUNNING GEAR FOR MINING CARS.—R. D. SCOTT and J. G. CADWELL, Box 944, Roslyn, Wash. The object of this invention is to provide an oiling arrangement whereby it will be insured that the journal axle of the running gear will be continuously and thoroughly lubricated. It is also an object to provide a journal box for the axles comprising a solid casting having a transverse recess in its lower base adapted for journalling the axle, and in which an oil retaining agent may be placed. (See Fig. 7.)

RAILWAY SWITCH HEATER.—W. T. LAWLOR, 68 Wayne St., Jersey City, N. J. The invention relates to switch heaters in the form of a plurality of oil pans which may be located between the ties and under the rails of a switch mechanism, and in which the oil is burned to keep the switches open in winter storms. A special object is to provide covers for the pans, which will prevent water collecting therein during rainstorms, but which may be quickly removed when the pans are wanted for use.

SAFETY DEVICE.—W. J. BURKE, 2532 Hillman St., Youngstown, Ohio. An object of the invention is to provide means by which any possibility of the switch being accidentally thrown upon a train passing over the same is absolutely prevented. A further object is the provision of a device which shall be entirely automatic, so that difficulty incident to the human equation is avoided, the construction being such that it will cause a complete throwing of the switch, even though the parts of the same have been left in partly closed position.

PNEUMATIC CONTROL FOR LUBRICATORS.—C. F. HOOFER, 549 West Washington Boulevard, Chicago, Ill. The invention relates to a device for controlling air for actuating lubricators. An object is to provide an automatic air control device which will operate when the control lever is moved, as, for instance, by the swinging of a truck when a train goes round a bend, and which will shut off the flow of air to the lubricator when the pressure has reached a predetermined maximum.

Pertaining to Recreation

GAME.—G. MILLER, Denham Springs, La. More particularly the invention relates to games involving the use of a board, movable pieces, and missile throwing devices, the purpose of which is to upset the movable pieces, the board being divided into playing surfaces, each being the objective field of the missile throwing device, the spaces being separated to form a dormant area for misplaced shots.

TOY VEHICLE.—F. H. MILLER, 138 Stephen St., Ridgewood, L. I., N. Y. The invention relates to a toy vehicle built to imitate an automobile. An object is to provide a body portion which will imitate the long, narrow body of a high-speed automobile, and to provide means whereby the operating parts of the vehicle are closed from contact with the operator as much as possible to prevent soiling the clothes of the child.

TOY SPINNING TOP.—J. POPPER, 143 West Broadway, New York, N. Y. An object of this invention is to provide a construction in which a top body is provided with means indicating a ball structure in action with an ornamentation therein. A further object is to provide a top with removable ornamentations or characters, and a handle which is so arranged that when the top is in action the handle will appear as a transparent ball, and the figures will appear to move.

AMUSEMENT DEVICE.—J. SAYIH, 408 Gold St., Brooklyn, N. Y. The principal object of this invention is to provide a device of the carousel type which includes a plurality of annular series of cars and means for driving the same in circular undulating paths and in opposite directions whereby to impart to the riders an amusing sensation, each series being driven at different rates of speed whereby the riders may have a choice of selection.

ELECTRICAL AMUSEMENT APPARATUS.—S. J. LEVI, 25 Milton St., London, England. The invention relates to an electrical amusement apparatus of the kind giving a visual or aural indication when a player has achieved success, by the provision on or above its surface of a plurality of electrical contact pieces connected with one or more indicating devices, and separate means adapted to be moved by the skill of the player on to said contact pieces so as to close the electric circuit.

INDESTRUCTIBLE TOY TRAIN.—R. E. BLOOMFIELD, 16 West Eleventh St., Jacksonville, Fla. It is the object of this invention to provide a practically indestructible toy railway car from a single piece of wood, which may be bored lengthwise for saving in weight, and which is otherwise of solid construction, with smooth, unbroken sides, although countered at the top so that by means of side decorations the representation of the car may be made unmistakable.

Pertaining to Vehicles

MOTOR CAR ATTACHMENT.—D. W. NEWBERRY, c/o Schell Motor Co., Virginia, Ill. The object of the invention is to provide an attachment especially adapted for use with Ford cars and for attachment to the clutch and low-speed pedal, for locking the transmission in the low-speed when desired, as, for instance, in climbing hills or in traversing mud, sand or the like, so that the driver does not need to hold the pedal in operative position with his foot.

MOTOR VEHICLE. — F. A. JOHANKNECHT, 179 Jayne Ave., Patchogue, N. Y. The invention has for its object to provide a motor vehicle the body of which when in motion is supported by two wheels, one of which is the guiding wheel and the other the tractor wheel. A further object is to provide mechanism in the form of a pair of small wheels which can be lowered by a pedal to support the vehicle in upright position when at rest.

AUTOMOBILE IDENTIFYING DEVICE.—C. W. ZINT, 206 Ft. Thomas Ave., Fort Thomas, Ky. The primary object is to provide means by which an automobile may be properly identified in order to prevent surreptitious use thereof. A further object is to provide two license plates at the front, which license plates contain corresponding data. During such time as the vehicle is not being operated, the upper license plate is removed by the owner, whereby it may be ascertained whether or not the automobile is being operated by the owner or a person unauthorized. (See Fig. 8.)

VACUUM BRAKE.—R. W. CATCHING, E. Oak St., Roseburg, Oregon. The invention relates to brakes for vehicles employing internal combustion engines, the primary object being the provision of an effective fluid pressure brake arrangement, actuated by the suction of an internal combustion engine and capable of attachment to the foot-actuated brake connections of an automobile, motor truck or the like, to permit of free actuation of the foot-actuated parts.

TRACTOR.—O. L. LEWIS, 336 W. 65th St., Chicago, Ill. The invention includes a frame and motor, a transmission case rearwardly of the motor, rear-driven wheels, a rotatable steering member in the forward portion of the frame, front steering wheels, an adjustable connection uniting the axle with the rotatable steering member, and hand-controlled power actuated connections leading forwardly from the transmission case and engaging the rotatable steering member to control and actuate the latter.

SPRING.—P. FERRIER, "Portland," Roma. The object of the invention is to provide a leaf-spring which is so completely encased that it is protected against the deleterious action and effects of rain, mud or grit, which ordinarily find their way to springs. The device is of extremely simple and durable construction, reliable in operation, easy to repair and maintain, and inexpensive to manufacture.

Designs

DESIGN FOR A SHOVEL.—F. A. VEDUTIS, Millburn, N. J.

DESIGN FOR AN OILCLOTH TABLE COVER.—C. BASTOW, c/o T. R. Goodlake & Sons, 350 Broadway, New York, N. Y.

DESIGN FOR A BOTTLE.—E. E. BAKER, Box 1187, Pittsfield, Mass.

DESIGN FOR A CHARM.—EMMA B. RIEGEL, 45 John St., New York, N. Y.

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Father Zahm Dead.—Father John A. Zahm, companion of Roosevelt on his journey through the South American wilds, and author of many works on South America, died in Munich on November 11th, 1921.

Bodies of Arctic Explorers Are Found.—The Russian expedition exploring Siberia has discovered the bodies of Knudsen and Tessen, two members of the Amundsen party who were lost in the winter of 1919. The bodies were found "near the mouth of the Janesey."

Oldest Medical Faculty.—The University of Montpellier, France, has a medical school tracing back to the tenth century; in the coming celebration of the 700th centennial of its official recognition, a monument to Rabelais, one of its brilliant alumni, will be unveiled.

The Value of Sunlight.—The Medical Research Council finds that the metabolism of children exposed to sun and air at the Treloar Hospital is nearly 40 per cent above that of children kept within doors; also that at the seaside the body-heat production is increased 5 times by paddling along the shore, and from 8 to 10 times by swimming.

A Gorgas Memorial in Panama.—A memorial, which will probably take the form of an institution devoted to research work, is to be erected in Panama to Surgeon-General Gorgas. His wonderful sanitation work in the Canal Zone is worthy of some such permanent testimonial. Funds will be solicited from scientific and philanthropic organizations and from individuals.

Mouse-Tracks in African Snow.—Prince William of Sweden obtained during his African hunting trip a fine zoological collection for the Royal Museum of Stockholm—1000 mammals, including 12 gorillas, 2000 birds, and more than 6000 insects. In climbing great volcanoes to an altitude of 13,000 feet he found snow on which were the tracks of mice, although intense cold prevailed there.

The Tides and Semi-Marine Life.—An English writer traces the abundance of sedentary or fixed forms and the widespread phenomenon of stereotaxis among free-swimming species to the direct action of wave impact; the shore zone, from its periodic changes in tide level, formed an effective bridge between aquatic and terrestrial life. The case of Convoluta is quoted in support of the theory.

Antarctic Discoveries.—J. L. Cope, the explorer, returned to Plymouth, England, a year ahead of schedule; he had discovered extensive, workable mineral deposits and gained valuable knowledge relating to fisheries, including the secret migrating places of whales. After exploiting these finds, he plans to go back, taking his wife with him, in which case she will be the first woman to set foot on the Antarctic continent.

Fire-Colored Sunsets.—An approaching hurricane may affect the atmosphere and the rays of light passing through it for more than a thousand miles. When a true flame-colored sunset is seen during the hurricane season below the 35th parallel, even when there is no particular fall in pressure, it is wise to hurry to safety. This awe-inspiring phenomenon may precede the sea swell and upper cloud movements by from 24 to 48 hours, and may be the only timely warning of the dangerous tropical storm of small diameter.

Prof. Nernst Elected Rector.—Walter Nernst, recently elected rector of the University of Berlin, is the inventor of the Nernst lamp. He studied under Helmholtz, was a coworker with Ostwald in developing the ion theory, is the author of scientific works, and in 1914 received the Nobel Prize for inventions. His election to the rectorship of the University, with which he has been connected for 15 years, emphasizes the dominance of applied science, in Germany, over academic considerations, and her desire to turn all education to practical ends.

Rasmussen's Program.—The motor schooner "Sea King," carrying the Knud Rasmussen Arctic expedition, left Godthaab, Greenland, on the 7th of last September for the coast of Labrador, where scientific investigations will be pursued; thence the party will proceed to Lyon Inlet, in the Melville Peninsula; and from there the vessel will sail to St. John's, Newfoundland. Rasmussen's task is to explore and map the archipelago between Greenland and the American continent, at the same time investigating the folklore and migrations of the Eskimos. Cape York Eskimos accompany the expedition.

The Seismograph Simplified.—In place of the delicately adjusted levers by which an earth tremor is translated into a line record, a new device uses a small mirror, so hung as to oscillate freely with any earth movement. This mirror receives a beam of light from an electric lamp, which is reflected upon a strip of sensitized paper moving continually at a uniform speed. Since the reflected ray moves through an angle twice that of the angular motion of the mirror the oscillations are magnified twofold. The paper strip, removed and developed, plainly shows the vibrations to which the apparatus has been subjected.

Possibilities of the Soya Bean.—"Manna" milk from the soya bean is now being made in Vienna at one-sixth the cost of fresh milk; in proteid, carbohydride and fat content, and in color, it closely resembles cow's milk, being, of course, free from milk-borne diseases. Butter and cheese can also be made from the bean, and "manna" flour, one part of which equals in nutritive value two parts of meat and one-third part of wheat flour. So, at least, Dr. Berczeller, a young Hungarian scientist, tells us; he designates the soya as an ideal food containing 40 per cent albumen and 20 per cent fat.

A Prehistoric Engraving.—The present owner of Jacobs' Cavern, near Pineville, Missouri, writes to *Science* of his discovery of a number of interesting artifacts including bone and horn awls and engraved and polished stone implements, with portions of an adult human skeleton. A most important specimen was a bone bearing on one side an engraving of what seems to be a mammoth or mastodon and on the other a deer. Dr. Clark Wissler of the American Museum of Natural History has been reexamining the cavern; photographs of the more important finds are being prepared, and a detailed report of operations will doubtless soon be made public.

Years Added to the Life Span.—Since 1909, according to the findings of the American Emergency Council's Committee on Elimination of Waste in Industry, the duration of life has lengthened by five years and the nation has benefited to millions of dollars by lessened disability and sickness. There is still a standing sick list of 2,400,000 persons, but this is a marked reduction from the 3,000,000 of 1909. The improvement is due, not to any physical advance of the race, but to "a mitigation of the struggle for existence and a protection of the community from communicable disease." A survey of five basic industries shows that the average individual now loses only seven days annually from sickness, as compared with thirteen days in 1909.

Luminous Watch Dials.—How radium, costing $120,000 a thimbleful, can be used on cheap clocks and watches is a puzzle to the average man. Properly understood, it is a demonstration of the remarkable powers of this substance. The paint used is a combination of zinc sulfide with an infinitesimal quantity of radium. Examine a luminous dial through a magnifying glass after the eyes have been in total darkness for a few minutes, and tiny flashes of light may be seen; these are caused by the explosion of hundreds of millions of radium atoms, and occur at the rate of about 200,000 a second; the more radium in the paint, the greater the number of flashes per second, and the more durable the luminosity. Since every flash means a blow upon a crystal of zinc sulfide, the crystals gradually break under the strain; the zinc breaks down in about five years, but the one-millionth gram of radium on the average watch dial is practically as energetic as ever.

Miscellaneous Notes

Muir Woods National Monument.—By public proclamation, President Harding has accepted and added to the Muir Woods National Monument, in California, 128.14 acres of land.

Chamois Disappearing.—The serious scarcity of chamois in the mountains of Savoy is laid to the war that, by raising the cost of living and increasing the gun-owning population, is responsible for new activity in hunting.

Branded Fruit.—Trade-mark branded oranges and grapefruit are in especial favor in New York. The electrical branding machine has now been so perfected that it will even brand tomatoes without bruising them or breaking the skin.

Ants That Eat Flowers.—A new type of ant, large, vicious and prolific, is playing havoc with the flower industry of the Italian Riviera. Horticulturists are required to report the appearance of this pest immediately and to take prescribed steps for its destruction. The ants are supposed to have been introduced from the Argentine.

Fur-Seal Shipments.—Last season up to September 15th, 11,260 fur-seal skins and 2514 gallons of seal-blubber oil were received in the United States from the Pribilof Islands, and 11,291 sealskins came from the islands of St. Paul and St. George; there were also shipped 228 gallons of seal-blubber oil, which was used for processing the skins.

Hand-Shaking and Nerve Breaking.—After his hand-shaking tour of Canada, the Prince of Wales could scarcely move his arm for days. A health expert states that the American custom of hand-shaking contributed toward the deaths of Roosevelt and Caruso and is responsible in part for Woodrow Wilson's ill health. "It breaks down the nerve system and invites disease," he says.

A Drive on the Prairie Dog.—In Niobrara County, Wyoming, prairie dogs infest 200,000 acres of farm land; each dog means a loss of more than $1 a year. The Biological Survey is cooperating with landowners to clean up these colonies of pests; in one such clean-up 99 per cent of the animals were destroyed. Free bait is furnished for government land, and county commissioners give financial help in the smaller sections.

Back to the Hour-Glass.—A miniature "hour-glass" is now being used to time the telephone conversation. Its upper compartment exhausts itself of sand in just three minutes; with one eye on the glass, the telephone user sees when the time is almost up, and can speed up his business accordingly, so that the talk may be finished within the specified three minutes of the long-distance call.

Palaces a Drug on the Market.—The great mansions that dot Central Europe, the former homes of departed royalty and nobility, are presenting something of a problem. There is no money to be spared for keeping those as historic souvenirs, or for turning them into museums and art galleries as France and England have done in some cases. It seems likely that they may be used as quarries from which the peasant may dig stones to construct his humble cottage.

Depositors To Be Finger-Printed.—All postal savings depositors must now be finger-printed; this supplements the present method of identification and safeguards both the paying postmasters and the depositors. The system was inaugurated on December 15th, and the prints are taken whenever an account is opened or interest or principal paid. Care is taken to disabuse the minds of depositors of any connection between this procedure and criminology; those who already have accounts will register their finger-prints in the first transaction following the installation of the system.

Paleolithic Religion.—The cave man buried his dead with as solemn religious rites as any in vogue today. Such is the conclusion of Prof. Mainage of the French Catholic Institute, from his painstaking studies of relics and ethnological records. Furthermore, he is convinced that their religion was not basically different from ours, and that the latter is merely an evolution of the former. The tombs and carvings reveal nothing in common with animism or totemism, although the cave man's belief undoubtedly accepted a plurality of gods, from which the idea of one supreme being later emerged. Prof. Mainage's investigations, while pointing to the evolutionary nature of religion, throw no light on the origin of the monotheistic concept.

Starrett Combination Square Now Made in Lower Priced Model

The Combination Square originated and perfected by L. S. Starrett is internationally known as one of the most popular and widely useful tools ever devised. Hundreds of thousands of Starrett Combination Squares have been sold in all parts of the world, and the Starrett Square is today recognized as the standard tool of its kind.

A definite demand has, however, arisen for a genuine Starrett Combination Square of a somewhat less expensive grade than the standard No. 11 Starrett Combination Square, and in response The L. S. Starrett Company has recently placed on the market its Combination Square No. 94, listed to retail at $1.50. This new square is made in 12-inch size only and is fully up to Starrett quality standards, differing mainly from the No. 11 squares in that the blade is graduated in 8ths and 16ths on both sides instead of the finer graduations found on the No. 11 squares.

For carpenters and others not requiring the finer graduations, the new No. 94 Combination Square will be found highly satisfactory. In this single tool is combined a marking gage, rule, square, miter, depth gage, height gage, level and plumb.

The two features last named are especially worthy of note as no other combination square now on the market made to sell at a price approaching that of the Starrett No. 94 Combination Square is furnished with level and plumb.

Flat Ends a Feature of New Starrett End Measuring Rods

Among many mechanics and others whose work or responsibilities require precision measurements, the new Starrett No. 137 Standard End Measuring Rods with *flat ends* are a welcome addition to the Starrett line of fine tools. The rods are made of steel approximately 7/16ths inch in diameter, with ends hardened, ground and lapped parallel and fitted with rubber handles designed to prevent change in accuracy due to expansion while in the hands. Sizes are 1 inch to 23 inches, or 25 MM. to 575 MM. The 1-inch size is made in the shape of a disc. Illustration and full details of sizes and prices of these tools are given in a special Supplement to the Starrett Catalog No. 22 B. Copies of both Catalog and Supplement may be had on request from The L. S. Starrett Company, Athol, Mass.

Civil Engineering Notes

The Queenston-Chippewa power development did its first work on December 28th, a 55,000-horsepower unit being started on its trial runs at that date. It was connected with its load about a week later, at time which a second unit of similar capacity went into its trial period.

A Mountain of Sulfur.—Attention is being directed to the existence of an island, Vanua Lava, in the New Hebrides Condominium, which is literally a mountain of sulfur, 1600 feet high and perhaps as much as 100 square miles in base. The material of the mountain is 99 per cent pure sulfur and the balance ash. It was formerly known, but in the uncertainty arising from conflicting administrative claims and conflicting concessions it was practically forgotten. Steps are now being taken to work it.

Use of Gas Masks in Railroad Tunnels.—The annual report of the Director of the Bureau of Mines for the fiscal year ended June 30, 1921, states that an investigation of gas masks for use of train crews in railroad tunnels was completed during the year. Results of the tests are being published by the Bureau of Mines in a technical paper entitled, "Tests of Gas Masks and Respirators for Protection from Locomotive Smoke in Railroad Tunnels, with Analyses of Tunnel Atmospheres," by A. C. Fieldner, S. H. Katz and S. P. Kinney. A small mask was devised that fits conveniently into a coat pocket, and in actual service with locomotive engineers and firemen was found to last two to six months before distasteful gas penetrated.

Ice in Hydro Intakes.—In response to a prediction that ice jams would prove a serious problem in working out power development schemes, a plan for heating the dams, valves, and gates of electricity generating plant slightly above freezing point in order to keep them free from ice was outlined before the International Joint Waterways Commission in session at Ottawa in November. A new type of turbine, which the Ontario Hydro-electric Commission proposes to use in the scheme was described by F. H. Rogers of Philadelphia. The electrical engineer to the Railway Commission, said that, in addition to heating the dams and gates, the machinery within the power plant also would be kept at a temperature above freezing point, thus eliminating any ice formation.

Trans-Zambesi Railway Completed This Year.—Satisfactory progress is being made with the Trans-Zambesi Railway, reports the *London Times* correspondent at Beirut, Nyassaland, East Africa. Probably it will be completed well before the end of the year to the southern bank of the Zambesi, opposite Chinde, where passengers and goods for the Nyassaland Protectorate will be ferried over to the Central African Railway pending an extension of the line up the southern bank of the Zambesi to Mutarara, where borings are now proceeding for the foundation of a great bridge to link up Beira with Blantyre direct. Construction of the line from Luchenza (south of Blantyre) direct to the southern end of Lake Nyassa, it is said, will be undertaken as soon as transport material is available by the Trans-Zambesi Railway.

The Waterproofing of Irrigation Canals is dealt with at some length in the Punjab Irrigation Technical Blue Book No. 20 by Mr. F. W. Woods. Commenting on the report, *Indian Engineering* says: "Mr. Woods' conclusions may be said to be pessimistic as to the value of all the remedies which have so far been the subject of experiment. The mileage of any great irrigation project in India, of canals, distributaries and water courses, is enormous; the cost of waterproofing to any great extent would be enormous also; and the lasting effect of any of the materials is questionable. The percolation, moreover, is not very excessive; and inasmuch as it can generally be adequately dealt with by means of surface drainage, it seems to be time that the experiments should for the present cease. This does not mean that the subject should never be revived. There may always be special localities where action is needed, and circumstances in the course of time may alter the whole position of affairs. But as far as the trials have progressed, and taking into consideration the evidence afforded both in India and elsewhere, the prospects of waterproofing canals on a large scale are distinctly unfavorable."

Mechanical Engineering Notes

Cleaning Large Gears, up to 30 feet in diameter, to remove the glass or silica and the mineral oil left on them by the grinding operation was formerly a two-day job for two men. A pit and roller bearing arrangement was installed whereby the gears might be hoisted upright and sprayed with a chemical solution from a hose while in rotation. The cleaning is now completed by one man in one hour.

Parabolic Milling Cutters.—In order to make the cutting tooth of uniform strength throughout its length, the shape adopted in a cutter recently put out is that of a parabola, slightly modified at the small end. The number of teeth for the entire circumference of the cutter is then more nearly that in the usual fine-tooth cutter than in the coarse-tooth models, so that the most effective chip thickness per tooth will be attained without excessive speed.

Two Operations in One.—The two wrist-pin holes in the opposite sides of an automobile cylinder look very much like two separate grinding jobs. A special double-headed grinder, with separate grinding heads carried on the same wheel slide, has just been put out to make them one, however. It is also available for a variety of jobs that involve the grinding of holes in opposite ends of long pieces not conveniently handled by means of a single long wheel-spindle.

Belt Tension.—A simple and fairly accurate method of determining this without recourse to a dynamometer test and without in any way interfering with operation is described in a recent issue of *Machinery* by N. G. Near. The formula used is $S = WL^2/8T$, where S is the sag, in feet; W the weight of the belt, in pounds per cubic inch; L the span of the belt, in feet; and T the cross-sectional tension of the belt, in pounds per square inch. Ordinarily W and L would be known, so that it would be necessary merely to measure S and substitute in the formula.

Pneumatic Collecting and Conveying Systems seem rather less well known than their merits would justify. In many industries there are operations or processes which litter machines or floors with refuse material or which throw dust, fumes or smoke into the air of the room. The collection, conveyance, reclamation or removal of these by-products frequently develops a problem in efficiency and cost that taxes the ingenuity and patience of the engineer. Pneumatic dust-removal, conveying, exhaust and air-washer systems are a few of the many possibilities inherent in the use of air for this sort of thing; and the cost and satisfactory operation are often surprisingly favorable.

Swaging, a process little known to the ordinary machine shop a few years ago, has recently come to occupy a place of considerable importance. For tapering, pointing and graduating tubes, rods and bars; in the manufacture of many delicate instruments such as those for the optician, the jeweler and the dentist; and in many other directions, it is fast taking the place of older and less satisfactory methods of attaining the same shapes. It is claimed by its exponents that it kneads the fibers of the metal closer together, and insures a tougher, stronger, and more elastic product than any competing process. However this be, it is certain that new uses for swaging are being found daily, and that it offers large opportunities for economy and improvement of product.

Electricity in the Steel Mill.—The electric plant-railroad is no longer a novelty; nevertheless some of its applications are comparatively new, and others involve difficulties of a sufficiently formidable character to bring forth the engineer's best efforts. When the current is carried on a third rail it is ordinarily found that anything in the way of an adequate protection to the workman will act also as a protection to the rail against short-circuiting by contact with extraneous bodies. An exception is in the case where the miniature electric transportation line is set up in the steel mill, where guard strips which might be altogether protective to passing workmen would be demolished and the third rail severely damaged by hot metal falling on the rail in good-sized quantities. This hazard, however, can be overcome by the use of the underneath contact, plus proper insulation, which makes the third rail entirely practicable in these trying circumstances. A system of the sort is described in *Iron Age* for December 29th.

Patents and Trade-Marks Notes

Language in a Patent.—There are few documents in English which require a more precise and well-chosen form of expression than does a patent. In fact, a patent claim, under the United States Patent Practice, is one of the most difficult expressions properly to formulate in the English language. Nevertheless, there is no hard and fast rule as to the use of the language which must be employed, nor of the kind of technical terminology to be used. This fact was recently reiterated by the United States Circuit Court of Appeals for the Seventh Circuit, in Rajah Auto Supply Co. vs. Belvedere Screw & Machine Co., et al. (275 F. 761), in which the Court held that a patentee may define his own terms, regardless of common or technical meaning, and his definition of words, phrases and terms will be accepted by the Court.

Consent Decree Constitutes an Agreement.—The United States Circuit Court for the Second Circuit, in a recent decision has declared (Wilson, et al., vs. Haber Bros., Inc., 275 Fed. 346), that a Consent Decree is an agreement of the parties and is to be interpreted as an agreement, and consequently, a suit for infringement of a design patent and copyright, resulting in a Consent Decree, by which the defendant specifically agreed that the Court should declare a trade-mark and copyright "good and valid in law," estops the defendant from asserting the patent and copyright to be invalid. The Court expresses no opinion as to the propriety of copyrighting the subject-matter in issue, *i.e.*, the "Kewpie" doll, but says that the defendant was at liberty to estop itself from contesting validity, and that by permitting the Consent Decree to be entered it had done so.

Loss of Trade-Mark Rights.—Trade-mark rights may be lost through abandonment, laches, acquiescence, misrepresentation or fraud, and any one of these causes may be interposed as a defense to an action for infringement. The question of intent on the part of the owner of a trade-mark determines whether the trade-mark has been abandoned or not, although sometimes an intent to abandon will be inferred from the acts of the owner of the trade-mark, and the circumstances. In Saxelehner vs. Eisner & Mendelsohn Co., 179 U. S., 19, the Court said: "To establish the defense of abandonment it is necessary to show not only acts indicating a practical abandonment, but an actual intent to abandon. Acts which, unexplained, would be sufficient to establish an abandonment may be answered by showing that there never was an intention to give up and relinquish the right claimed."

Expanding Limited Patent Claims.—Attention is called to a recent decision of the U. S. District Court for the District of Connecticut, in the case of Menzer vs. Kenworthy, 275 Fed. 249. In this case the court adds another to a relatively long list of precedents showing that while the claim of a patent may be limited in language to the exact construction shown and described in the drawing and specifications, yet if the state of the art warrants the court in so doing, such claim will be interpreted to protect the patentee against one who, while not following exactly such construction, nevertheless uses a mechanical equivalent. In this particular case the machine of the patent, a metal blocking machine, embodies a carrier and a yoke for the blocking belt, comprising a pair of standards and a pair of side members, while in the defendant's machine the carrier had but a single standard and the yoke had but a single side member. The claim at issue specifically describes the construction as one in which there is a pair of standards supporting the yoke. In finding that the defendant had infringed, the Court stated: "Being satisfied that the invention is substantial and meritorious, the strict interpretation insisted upon should not be put upon the claim. It is immaterial, in view of the state of the art, whether one or more standards are used, or whether a yoke or its equivalent—a rigid frame member—is pivoted to one or more standards, the same operations and the same functions result. Neither need the height of the standard or standards be considered, as long as the standard or standards and the yoke or its equivalent are located on diametrically opposite portions of the block." The Court thus followed a long line of cases beginning with Winans v. Denmead, 56 U. S., 329, wherein apparently limited patents have been interpreted, but where the state of the art warranted it to cover the real invention and thus afford to the patentee that protection which the law contemplated.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Renewable Fuse Plug.—An American concern has been working on the problem of a renewable plug fuse for some years past—a plug fuse so simple that anyone could refill it and put a line back into operation. It is of the Edison type and renewable, for use on circuits of 125 volts with ratings from 3 to 30 amperes. The fuse consists of three parts, the body, the cap, and the refill. The cap and the body are of heat-resisting molded insulation. The refill is stated to be an ingenious little cartridge, properly vented for the emission of the gases when the element vaporizes, and has the rating of this element stamped on both ends so that it is always visible through the aperture in the cap, regardless of how it is inserted in the body.

Electrical Progress in Sweden.—According to the *Swedish-American Trade Journal*, while the available statistics for 1917 give the electrical acreage of cultivated land in Sweden as 6.4 per cent of the total arable land of the country, the corresponding statistics of 1920 show about one-third of the cultivated ground to be electrified. Hydroelectric power plants abound in Sweden, in large and small units; indeed, there is a growing tendency for inhabitants of various regions to club together and install turbines in the rivers in order to supply local needs. Electric cooking is growing in popularity in Stockholm, and the central station company is planning reduced rates for this service.

Electrification of Japanese Railways.—More than 2000 miles of Japanese railways have been designated for electrification by the commission having this matter in hand, according to the *Japan Times and Mail*. This mileage is classified as follows: 1. All sections in the suburbs of cities where there is a heavy railway traffic, 186 miles. 2. Sections of high gradient where there are many tunnels and also those where abundant water power can be utilized, 871 miles. 3. Sections where shortening of the line is required and where water power can be utilized, 395 miles. 4. Sections where increase of transportation capacity and shortening of the line are required, 295 miles. 5. Sections where available water power can be utilized, 265 miles. 6. Sections where increase of carrying capacity is required and where coal can be obtained at a low price, 146 miles.

Kites and High-Tension Cables.—From various parts of the country come reports of serious and even fatal accidents due to the flying of kites with fine wire in place of the usual string. It appears that youngsters, in their desire to obtain higher altitudes for their kites, substitute fine wire for heavy string. There are several recent instances of such kites and fine wires coming in contact with high-tension wires or cables with unfortunate results. From California, for example, comes news of this tragedy: One man was killed in Los Angeles, one boy crippled for life, and two others so badly burned that they were confined to the hospital, because one progressive youngster used a metal string for his kite. We learn that a boy in Flint, Mich., was killed last August in a very similar manner. It might be well to impress on youngsters the danger of using fine wire of any kind in kite-flying.

A Low-Candlepower Electric Lamp.—A solution of the very low candlepower electric lamp problem is believed to be afforded by a lamp recently introduced in England. The outward appearance of this new lamp is much the same as that of the usual British electric lamp, and is fitted with a standard bayonet clip base. However, an examination of the inner details of the lamp discloses the fact that it is of the electric discharge or ionic bombardment type. The bulb contains a small quantity of neon gas, and there are two metal electrodes placed a short distance from each other and between which the discharge takes place. The outer metal electrode or cathode is of wire, wound in helical shape, and when the lamp is energized a luminous haze appears round this cathode and provides the source of light. The light is somewhat orange, of a pleasing color, and being rich in red and yellow rays is well visible at a distance. The lamp is obtainable in 200 to 220 volts, and 221 to 250 volts. The energy consumption is 5 watts.

New Tungsten Arc Lamp.—From Holland comes word that a lamp works has developed a new type of tungsten arc lamp. In this new lamp an arc discharge takes place between small tungsten spheres in an atmosphere of rare gas. The lamp has also a great advantage in that it can be run on a 200-volt alternating current circuit, and except for a series resistance, no auxiliary apparatus is necessary. The voltage on the arc itself is about 25 volts. In order to ensure the striking of the arc a third electrode is mounted in the lamp and a high resistance in the cap or base of the lamp connects this third electrode to one of the leading-in wires. The material and the form of this third electrode have been chosen in such a way that a glow discharge sets in first between it and the electrode next to it, so starting the discharge between the small tungsten spheres. A funnel-shaped screen is provided, on which the evaporated and spattered tungsten is deposited in order to prevent the blackening of the bulb. Lamps with a current consumption of 1 and 2.5 amperes are now available, larger sizes being in preparation. Experiments with direct current lamps are now being made.

Carrier Current.—A demonstration of the application of "carrier current" communication from a moving car was recently made and represents an important advance in electric train operation. The system was developed to provide better means of communication between the locomotive and caboose of long trains and between trains and substations or waiting rooms of electric railroads. The operation of the system, according to *General Electric Review*, is as follows: The trolley wire, carrying current to the electric locomotive or trolley car, is used as a carrier of telephone communication by means of another current of different frequency, which is superimposed on the wire and travels along with it. This "carrier current," properly modulated by speech, is drawn off by special apparatus to a telephone instrument. At another point along the line, however, the message speeding along the trolley wire may be transmitted short distances through the air and made to energize an instrument in a substation or waiting room, becoming audible through a receiver. In effect, the system transmits messages electrically partly over a wire and partly through space. In tests engineers have not only been able to telephone but to operate relays, light lamps, and start and stop one car from another car at a distance of a mile and a half. Communication by this means has been effected successfully over distances of from 40 to 60 miles.

Electrolytic Protection of Steam Boilers.—A method said to be successful in protecting steam boilers against their two greater enemies, corrosion and boiler scale, is described in a recent issue of *Siemens Zeitschrift*. Careful investigation of corrosion on boiler bottoms, water tubes and condensers proved, according to W. Philippi, the author, that electrolytic action was the cause of these damages. As a remedy a metal of higher e.m.f., like zinc, has been connected electrically to the boiler to create a counter e.m.f. to compensate for the corrosion current. But this method did not always give complete satisfaction, as it was impossible to regulate the current. An externally generated direct current applied through electrodes into the boiler was found to be a perfect remedy. In fact, by doing this the small but constant generation of hydrogen along the boiler walls will also effectively prevent the formation of boiler scale. A direct current voltage of from 10 to 20, at a current density of about 2 milliamperes per square foot, was found to be most effective. A small motor-generator of 6-kilowatt capacity may supply a battery of 13 boilers, each of which may have four protective electrodes. A small resistance in series with each electrode circuit permits of suitable regulation of the voltage. Ordinary wrought-iron gas pipes are used as electrodes. Experience with this protection, extending now over several years, surpassed all expectations.

Wild Life Notes

Cat May Use Claws in Defense.—Boston woman sued for damages sustained in an attempt to separate her dog from a grocery-store cat. The Supreme Court held that the woman voluntarily submitted herself to danger and had no recourse in law.

Mastodon Ivory Sought. — Genuine ivory is exceedingly scarce, and many hunters have left Seattle this past summer to prospect the Yukon and Norton Sound tundras for mastodon tusks. Another source of supply is the Behring Sea walrus and narwhal.

American Museum Acquisitions.—Two treasured additions to the American Museum are an incomplete skull of the European bison or wisent, and a fine skull and jaws of the urus or extinct wild ox of Europe, which is probably the remote ancestor of our domestic cattle. Both these came from the Cambridge (England) Museum of Zoology.

Steel Jaws Are Cruel.—One-fourth of the animals caught by steel traps are worthless; 15 per cent. escape by chewing off a leg. Many are eaten by other animals; all suffer lingering torture. The American Humane Society offers prizes aggregating $300 for the best essays acquainting the public with this cruelty and showing how it may be remedied.

Antivivisectionist Converted.—M. E. H. Baynes, indignant at the wanton cruelty imputed to the vivisectionists made careful investigation. In his article, "The Truth About Vivisection," in the *Woman's Home Companion*, he declares that antivivisectionist propaganda is deliberately misleading, that the laboratories handle their animals with the utmost kindness, and that their work has furnished knowledge of the highest value in diphtheria, antitoxin, asepsis, antityphoid vaccination, and the transmission of yellow fever.

The Bite of the Gila Monster.—*Natural History* has an instructive little article on the Gila monster. Authorities differ as to the deadliness of its bite; but no really authentic case of human death from this source has been forthcoming. The poison is fatal, but it seems that the animal is unprovided with means for ejecting it; the glands are in the under side of the mouth, imperfectly connected with the teeth, and, as Dr. Leo Loeb points out, liquids won't flow uphill. One Gila monster was adopted as a playfellow by a five-year-old girl, and never offered to bite her; another, after being safely handled by a museum attendant for a year, inflicted the worst bite on record, but the man recovered. The poison seems generally to be wiped off before it can enter the wound.

Passing of the Sea-Horse.—That curious little fish, *Hippocampus hudsonius*, commonly known as the sea-horse, has been growing scarcer in the northern ranges of the Atlantic coast waters during recent years. The gradual extinction of this picturesque animal is believed to be due to the heavy fuel-oils used in sea-going vessels. The thousands of gallons which are wasted into the sea cause the death of the small crustaceans which form the sole food of the sea-horse. So serious has this menace become that it is threatening the shellfish and other inhabitants of our shore waters which are of economic value. With the constantly increasing number of oil-burning ships, it is evident that unless this needless wastage is abated the consequences will be disastrous. In fact, legislative action is a desideratum right now.

A Baby Tapir.—A Malayan tapir born recently in a London "zoo" is attracting attention, partly by reason of its being the first recorded birth of these animals in captivity, but mainly for the remarkable instance of protective coloration which it exhibits. It is strongly striped and spotted with white on a black background—a feature making it extremely invisible in the broken lights and shadows of its natural habitat, the jungle. The mother, on the other hand, is totally different in her markings. She is jet black over the entire body with the exception of a broad white patch extending over her back and haunches to her belly. The explanation of the change in markings which takes place as the tapir gets older is found in its change of habits. When the animal grows it leaves the recesses of the jungle and frequents shallow streams or dried river courses where boulders are plentiful. This adaptive change of striped markings to expansive patches enables it to lie safely concealed in its new surroundings.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

A New Crystal Detector is described in a French patent granted to R. Pedegert. The new detector is one in which the known properties of galena are employed in a novel manner. The device consists of a container partly filled with mercury and hermetically closed by a plug of insulating material through which pass two terminals on the inner ends of which are carried galena crystals, which dip into the mercury.

The Loud-Speaker is virtually the backbone of successful radio-phone reception. When wearing head receivers one is apt to hear too many of the disturbances and howls existing in the various circuits, especially if the signals are brought up loud. However, with the loud-speaker in operation it is generally possible to hear the voice or music loud and clear above the parasitic sounds, which makes the radio-phone service all the more popular and enjoyable.

Transmission Strength.—From a recent issue of *Radio Review* we learn of the investigations carried out to measure the strength of radio signals sent from Lyons and Nantes, in France. Reception at ranges of 7000 to 10,000 kilometers were made, in which comparisons were drawn between day and night receptions. Signals were found to be weaker in the Pacific than in the Indian Ocean, and the audible range of signals was not symmetrical.

Operation of Modulator Tube.—According to E. S. Purington, writing in Scientific Paper No. 423 of the Bureau of Standards, the most satisfactory method of modulating the output current of an electron tube generating circuit is by variation of the operating plate voltage. A study is made of: (1) Operation of the modulator tube as an aperiodic power amplifier; (2) the actual load impedance of a tube acting as an amplifier; (3) imperfections of the audio choke coil due to its reactance; (4) the audio impedance of parts of the generating circuit, and (5) the presence of electromagnetic energy in the radiator unit. The signal strength under conditions of no distortion, using a receiving set with square law of reception, is proportional to the difference between the peak radio power and the minimum radio power in the transmitter radiator unit.

Supersensitiveness and Distortion.—The extent to which the sensitiveness of the regenerative receiving set and two-step amplifier may be raised is nothing short of marvelous. However, there are certain critical adjustments where the utmost sensitiveness is obtained, but only at the expense of serious distortion and howling. Indeed, it is aggravating, under such circumstances, to be receiving radio telephone music and talks amid such noises that good reception becomes quite impossible. Thus, with a 60-foot piece of wire serving as the aerial one may be able to pick up Pittsburgh radio-phone broadcasting station in the vicinity of New York, but only by means of maximum regeneration and two-step amplification. What is gained in loudness is sacrificed by clarity, so that in the long run nothing is really gained. And here, precisely, is where the radio frequency amplifier comes into use, for it can amplify the signals themselves before they are brought to the detector to be rectified.

The Negative Resistance Valve.—Considerable interest has been aroused by the so-called "Negration," which, as its name implies, is a negative resistance valve. According to *The Electrician*, this valve is used as a continuous wave generator and has found a wide commercial application, particularly on board vessels of the mercantile marine. More recently much has been heard of magnetic control thermionic valves, as vacuum tubes are called in England, for producing oscillations, although it is too early to say if they will find a practical application. The Admiralty carried out a great deal of very valuable work in connection with high-power vacuum tube transmitters. They successfully used multiphase currents for supplying the anodes of transmitting tubes without the use of rectifying valves. The installation at Horsea was very successful. It seems likely that the experience gained at that station will lead to a very much wider use of high-powered tube sets.

Radio Taste Reception.—In a recent issue of *Proceedings of the Institute of Radio Engineers* there are described certain experiments made to determine the feasibility of reception of radio telegraph signals by the sense of taste. Silver electrodes were used, one of which made contact with the inner part of the upper lip of the operator and the other with the tip of his tongue. With a direct-current circuit it was found that the observer could detect a potential difference across the electrodes of 0.4 volt. A potential difference of 2.0 volts was considered sufficient for the transmission of signals. With an alternating-current circuit these values were not very much different, but the element of fatigue did not seem to be so noticeable and the taste sensation appeared to be more continuous. In actual experiments using radio reception and four-stage amplification, it was found possible to detect signals the audibility of which in the detector circuit was 500 or more. It was also found possible to tune in a station by noting when the intensity of the taste sensation was a maximum. But for messages to be read the speed must not be greater than 10 words a minute.

What Makes Radio Work?—All kinds of explanations have been offered as to how the radio waves travel from the transmitter to the receiver. In a recent lecture given before the Royal Society of Arts, Prof. J. A. Flemming, the well-known radio authority, gave a new explanation. After a discussion of the propagation of electromotive waves, Dr. Flemming proceeded to explain that the presence of the highly conducting layer in the upper regions of the atmosphere, in which the component gases are hydrogen and helium, is probably due to electrified dust which comes to us from the sun, from which it is repelled by the radiation pressure against the gravitation attraction. He said that this dust came from the sun with enormous velocity and entered the higher levels of the atmosphere and rendered it conducting. This conducting layer guides the radio waves round the earth and prevents them from escaping into space. The lecture concluded with some remarks on the effect of recent physico-mathematical speculations on relativity, and especially the agnostic view now taken as regards the existence of a space-filling ether, on the theory of radio-telegraphy. It is clear that space is not a mere vacuum, but has remarkable powers of storing and transmitting energy, but modern physical and astronomical discoveries have rendered necessary great modification in our ideas regarding the structure of space or the ether and no theory of radiation has yet been propounded which satisfactorily explains all the known facts.

Transatlantic Radio Transmission by Amateurs.—In another part of this issue appears an article on the recent transatlantic transmission experiments by amateurs. The list of American amateur stations that were copied by the American observer station in Scotland is as follows:

1AFV, Salem, Mass., C.W., 200 meters; 1TS, Bristol, Conn., C.W., 200 meters; 1RU, West Hartford, Conn., C.W., 200 meters; 1DA, Manchester, Mass., C.W., 200 meters; 1AW, Hartford, Conn., Spk., 210 meters; 1BCG, Greenwich, Conn., C.W., 230 meters; 2BML, Riverhead, L. I., C.W., 200 meters; 2FD, New York City, C.W., 200 meters; 2FP, Brooklyn, C.W., 200 meters; 2OM, Ridgewood, N. J., Spk., 200 meters; 2EL, Freeport, L. I., C.W., 200 meters; 3DH, Princeton, N. J., C.W., 210 meters; 4GL, Savannah, Ga., C.W., 200 meters; 3BP, Newmarket, Ont., Spk., 200 meters; 8DR, Pittsburgh, Pa., C.W., 200 meters; 9KO, St. Louis, Mo., Spk., 200 meters; 9AW, Toronto, Ont., C.W., 200 meters; 1ZE, Marion, Mass., C.W., 375 meters; 2ZL, Valley Stream, L. I., C.W., 325 meters; 3ZO, Parkesburg, Pa., C.W., 360 meters; 5ZZ, Blackwell, Oklahoma, Spk., 375 meters; 6XH, Stanford U., Cal., C.W., 375 meters; 7ZG, Bear Creek, Mont., Spk., 375 meters; 8XK, Pittsburgh, Pa., C.W., 375 meters; 9ZY, Lacrosse, Wis., C.W., 260 meters; 9ZN, Chicago, Ill., Spk., 375 meters; 9XI, Minneapolis, Minn., C.W., 300 meters.

Government Activities

Mine-Layers as Life Savers.—As part of the Government's economy program, Navy mine-layers will be used to lay buoys, so Administration officials say.

Mosquitoes in the Yosemite.—Malaria-carrying mosquitoes have been found in Yosemite Park, and the sanitary engineers of the U. S. Public Health Service are doing their best to eradicate them.

Safety First for the Silo.—The Department of Agriculture warns the farmer against entering a partly filled silo until the machine blower has been in action for at least two minutes; the carbon monoxide gas has often caused death. Only recently two Illinois farmers were killed in this way. It is well also not to wedge the silo doors into place until absolutely necessary.

Code Words and the Weather Bureau.—The 4500 weather reports transmitted twice daily by the Bureau total more than 3,000,000 code words annually. About 170 station reports are reciprocally distributed over 21 circuits. Thus each day there is placed before the public, the country over, full knowledge of weather conditions in all sections of the United States and adjoining territories.

Not All Dusts Are the Enemies of Mankind.—The Bureau of Mines is encouraging the use in coal mines of barriers of certain rock dusts which, when jarred by the explosion of coal dust, scatter and act as a screen for the stoppage of the exploding coal dust. The dust waste from slate quarries, amounting to about 90 per cent of the entire material mined, has been found by the Bureau to be peculiarly adapted to use as a filler in the making of asphalt road surfaces.

Fine Map Work.—For 34 years the U. S. Geological Survey has been carefully mapping not only mineral features but also the results of topographical surveys valuable from many points of view. In this time 3000 engraved maps have been issued, and the program will eventually cover all the territory of every State. About 40 per cent of this program is completed, including all New Jersey, Connecticut and Rhode Island, and about 90 per cent of New York. Several States are cooperating, and in 1920 contributed nearly $200,000 to the work.

Petroleum Laws.—The publication of a Bulletin, "Petroleum Laws of all America," by J. W. Thompson, law examiner, is announced by the United States Bureau of Mines. The bulletin includes the petroleum laws of the United States, the several oil-producing States, Canada, Mexico, and the Republics of Central and South America. The report has been prepared in response to the wide demand for information regarding the laws regulating leases and concessions, and the explorations for and exploiting of petroleum in these Republics. It is sold at production cost.

Non-Metallic Building Materials.—The Bureau of Mines is studying the technology of cement and heavy clay products and experimenting as to selection of raw materials, the economical use of fuel, and problems of transportation; basic problems connected with clay-burning are being attacked, and phosphate rock, feldspar, slate and potash will also come under scrutiny. The object is to accumulate technical and economic data that will enable the many small, scattered plants to develop improved technology, so *Chemical and Metallurgical Engineering* informs us, with a view to placing the manufacture of these materials on a basis that will eliminate unnecessary costs and wastes.

Gasoline Production.—Statistics compiled by the United States Bureau of Mines show that the production of gasoline throughout the country for the first six months of 1921 amounted to 2,573,543,547 gallons, an increase of 18 per cent over the production for the same period in 1920. Imports of gasoline for the first half of 1921 were 14,835,056 gallons, or 32 per cent less than the imports for the corresponding period in 1920. A comparison of the consumption of gasoline for the first half of 1921 with that of the same period in 1920 shows that the exports, amounting to 286,564,514 gallons, are approximately the same, while shipments to insular possessions, amounting to 14,861,489 gallons, increased 45 per cent and the domestic consumption 1,998,689,989 gallons, increased by 8 per cent. Stocks of gasoline on hand June 30, 1921, were 750,644,450 gallons, or 49 per cent larger than the stocks a year previous; compared with the stocks of January 1, 1921, they show an increase of 62 per cent.

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Notes and Queries

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(14400) J. L. H. asks: Can the velocity of heavenly bodies be revealed and their motions calculated by the aid of their spectra? 2. In case of a star that was traveling head on to the solar system, would the bands of color of the spectrum be affected, or moved in any way, and if so, what would be the explanation of this? A. The motion of stars toward or away from the earth is determined wholly by their spectra. The motion across the line of sight, which is called its proper motion, may be determined by the position of the star after a long interval as compared with its position at the beginning of that interval. The right ascension and declination of many stars are slowly changing. This would be the real motion if the star were moving directly athwart the line of vision; but if moving obliquely to the line of vision it would not be the real motion. It would be but one component of its real motion. The component of its real motion which is directly toward or away from the earth is determined by the shift of its spectrum lines toward the violet or the red of the spectrum of the star, as compared with the position of the same lines in the spectrum in the laboratory. If a star is coming toward us the frequency of its light is increased by the amount of its motion toward us. This shortens the wave length of its light and moves the spectrum lines toward the violet, and conversely, motion away from us reduces the frequency of the light and the lines move toward the red end of the spectrum. This is true of all heavenly bodies. The side of the sun which is approaching us has its spectrum lines affected as well as those of the side which is turning away from us. Thus the velocity of the rotation of the sun is determined. So, too, is the velocity of rotation of a sun spot.

(14401) H. H. J. asks: 1. In pumping up automobile tires I have never been able to inflate them to as high a pressure as is shown on the air tank gage (I mean at times when the tank pressure is but slightly more than what I need). For example, the tank gage shows 80 pounds pressure, but I can not inflate a tire to more than 70 pounds pressure. The kind of air tank that I am referring to is about 4 feet long, 1½ feet in diameter, mounted on wheels and equipped with an electrically-driven air pump. Why don't the tank force air into a tire, or anything for that matter, until the pressure is the same in both tank and tire? I don't see why the tank in the above-mentioned case won't inflate the tire to about 75 or 76 pounds, while the tank itself falls from 80 to 75 or 76 pounds. 2. Chemistry texts say that a saturated salt solution freezes at —21 degrees centigrade, and therefore a mixture of ice, solid salt, and a solution of salt can stay together permanently only at this temperature. The result is that more ice will continue melting, thus absorbing heat until the temperature is lowered to 21 degrees centigrade below zero. I do not see how the salt solution falls below 0 degrees C. when everything else around it is 0 degrees C. or above. Can you explain? I understand that the solute or substance dissolved uses up some of the heat of the solution in its process of dissociation or ionization. Is that how the salt and water mixture falls below 0 degrees centigrade? 3. In riding along the country roads at night I have often noticed what seems to be a peculiar reflection of light from the trees and telephone poles which are not at all in line with the light rays from the headlights. At a distance of 100 feet or so a blotch of light appears on the pole and seems to approach the automobile as the car nears the pole, and then dies out. Sometimes I ride for miles without noticing it, and perhaps in the next mile it occurs repeatedly. What causes the blotches of light and why don't they appear on all the poles? A. 1. There may be several reasons why you can not get the same pressure in your tire as was shown on the tank gage. The tank gage may not be as accurate as your tire gage. Then the pressure of the valve spring must be overcome, if there is one. This is to be subtracted from the pressure in the tank to find the pressure in the tire. Again, the air taken from the tank reduces the pressure in the tank itself, unless the pressure in the tank is maintained by constant pumping while the air is being drawn off into the tire. If there were no pumping in of air into the tank and the tire took half the air in the tank, the tire pressure would be but half of the tank pressure at the beginning. So, too, of other ratio of tank and tire. 2. Heat always disappears in the solution of any solid, even when no heat from without is applied to produce solution. With a delicate thermometer, such as a thermopile, the drop of temperature by dissolving salt in water carries the temperature of the mixture below the temperature of the place where it is formed. It is not at all strange that a solution of salt and ice should cool in dissolving each other. The lowest temperature which can be had in this way is 22 degrees C. below zero C., which is 7.6 below zero Fahrenheit. The heat required to dissolve a solid must come from somewhere. It will come from the easiest place to obtain it. In this case it is taken from the liquid itself if care is used that it shall not be taken from outside bodies. We do this in freezing ice cream. The heat necessary to dissolve the salt and ice is taken from the cream, though in common freezers some heat does get in from outside to delay the freezing. 3. The light which you see reflected from the trees must come from some source in your car if there is no other light about. It is not probable that there is anything occult about it.

(14402) E. A. C. asks: In a recent issue of SCIENTIFIC AMERICAN I remember reading that our days were becoming longer at the rate of one (1) second every eight hundred (800) years, possibly due to the slight slowing up of the earth's rotation on its axis. If I remember this article correctly, would it not be possible to figure approximately the beginning of time? A few billion years ago the earth must have rotated on its axis once an hour or once a minute, possibly once a second, and in a few billion years our day will have approached the length of our month or maybe our year. A. We note your statement regarding the change in the rotation of the earth and the length of day, and we should challenge the statement that the day is becoming longer by a second in 800 years. Todd, in his New Astronomy, page 128, says that "a change of the Earth's rotation as great as a thousandth of a second in a thousand years could not escape detection," and no such change has been detected. Moulton's textbook of Astronomy, the latest we have, discusses the matter on pages 77-89, and concludes that the tides could not increase the length of the day more than a second in 500,000 years. And later he says that all the causes would have an inappreciable effect in 100,000 years. The uniformity of the earth's rotation on its axis, which causes the day, may be taken as settled for the present epoch. If such a slowing up of the earth were taking place we fail to see how this would indicate the beginning of time. At the most it would show how long ago the earth would have had a day of any desired length, an hour or a minute, provided the change had existed at its present value for such a time. But if the earth had a planetesimal origin, as many astronomers of repute believe, the rotation must have been very different at different periods of its growth. It is not a problem to be settled this year.

The First, and Last, 18-Inch Naval Gun

(Continued from page 234)

built-up type of ordnance, thus falling into line with American, German and French practice. The 18-inch gun is 40 calibers in length. Its weight unmounted, but including the breech-plug, is 152 tons. The armor-piercing projectile weighs 3320 pounds, and with a full charge of 690 pounds of cordite develops a muzzle energy of 150,000 foot-tons. It is theoretically capable of perforating 41 inches of hard-faced armor at short range, or 20 inches at a range of 10 miles, though it need hardly be said that hard-faced armor of this thickness has not been made as yet. The whole of the armor-piercing shells for this gun were made by Hadfields. The rate of fire on a naval mounting, as installed in the "Furious," is two rounds per minute. Initial firing tests showed the gun to possess a degree of accuracy, especially at ranges over 15,000 yards, superior to that of all lighter weapons. Given the necessary elevation and proper spotting facilities, it could make accurate practice up to 50,000 yards, and there is no doubting the tremendous destructive effect of a well-placed salvo of 3320-pound shells.

As I mentioned in an article on the new British battle cruisers, published in the December SCIENTIFIC AMERICAN, the British Naval Staff would probably have selected 18-inch guns to form the armament of these ships but for the fear that such a step would give an impetus to naval rivalry between the Powers, since neither the United States nor Japan would have remained content with the 16-inch gun when weapons of greater power were afloat in British vessels.

It is just as well that the introduction of 18-inch guns has been indefinitely postponed, for the increased weight of ordnance has been one of the prime factors conducing to the enormous size and cost of modern capital ships. The influence of armament in this connection is revealed by the following figures, showing the weight of a battery of eight big guns twin-mounted in turrets on the center-line of a ship: Eight 12-inch 50-caliber guns, total weight 3250 tons; eight 15-inch 45-caliber guns, total weight 5300 tons; eight 16-inch 45-caliber guns, total weight 7100 tons; eight 18-inch 45-caliber guns, 8900 tons. Now that the Washington Conference has fixed the maximum displacement of future capital ships at 35,000 tons, it is improbable that any navy will adopt guns of a greater caliber than 16 inches, for if this caliber were exceeded it would be impossible to mount more than six guns in each ship, thus sacrificing the volume of fire which experience in the late war showed to be essential at long-range action, when the percentage of hits is bound to be small, however accurate the pointing and spotting may be.

The only 18-inch gun which came into action against the Germans was that mounted in the monitor "Lord Clive." This was in the closing days of the war, when the Germans were evacuating their strongly fortified positions on the Flanders coast, and it was thought that a few rounds of 18-inch shell might hasten the process. An officer, who was on board the "Lord Clive" during the bombardment, states that the mounting allowed for a bearing on the starboard side only, with a maximum elevation of 45 degrees and a lateral deviation of 5 degrees, giving a nominal range of 45,000 yards with full charges. In actual practice this was probably much exceeded.

Exactitude in Propeller Manufacture

(Continued from page 261)

box. Then the whole assembly is rolled over and the wooden pattern (Fig. 1) is withdrawn. The drag, with its sand mold, is then baked.

A similar operation is performed with the cope container (Fig. 1) and the cope or metal flask (Fig. 2).

As every point in cope and drag pattern has been accurately established from surfaces and locating holes, it will be seen that the molding operation has mechanically transferred these pattern forms to a position within the drag and cope molds, this position being accurately established with regard to their respective surfaces and locating holes. After baking, the cope and drag are closed and secured together, as shown in Fig. 4; and thus the plate form and thickness are established and controlled.

In Fig. 5, three drags are shown assembled on the surface plate, to which they are bolted through holes H. Since every point in the mold impression is established with relation to the surfaces and locating holes, so by the securing of the surfaces of molds to the assembly plate by the locating holes, each point in each mold is established from the assembly plate with identical relation with the corresponding point in each other mold. Thus is established pitch uniformity, blade thickness uniformity, accurate blade location, et cetera, when the assembled mold is ready for pouring. The propeller being accurate to design, no corrective machining is required. For wheels built integrally and for commercial use, the equipment is built in three standard sizes, 12 feet, 16 feet and 20 feet in diameter; and each unit is designed for either 3- or 4-blade wheels.

The result of these methods of mechanical precision as described above are shown in the two following tests of propeller wheels.

On a series of five vessels of 8800 tons deadweight capacity equipped for the United States Shipping Board and having a designed speed of 10½ knots per hour, in trials speeds as high as 13½ knots per hour were attained. The following comparison of the old and new methods of casting on 3-blade Navy bronze destroyer propellers, 9 feet in diameter and 9 feet 11 inches pitch, are significant.

Advantages of the Thacher Process are as follows: The requirements of design are accurately met and the finished propeller is perfect in diameter, pitch, pitch uniformity, area of blades, blade location, uniformity of metal distribution and balance. As compared to the machine-finished propeller there will be a material saving of approximately 50 per cent, and the production time in the case of large propellers will be reduced two to three weeks for each propeller. The costly machine work formerly required is eliminated, thereby saving not only time and material, but the initial machinery investment, maintenance, tool and depreciation charges. The process permits of standardization of manufacture, which not only means greatly lessened cost and time of production, but assures the exact reproduction of a propeller for replacement purposes. It permits of quantity production of a quality and at a cost hitherto considered unattainable, and eliminates propeller vibration. The process does not require skilled molders, the molding being purely mechanical. Any intelligent man can be trained in a few days to perform the work. By elimination of machining the casting skin is retained, maintaining the strength of casting as well as its corrosive-resisting qualities, both of which suffer under machine tooling.

The Planets for April

Mercury is a morning star at the beginning of the month, rising at 5:15 A. M. He is drawing nearer the sun and is soon lost to view. On the 24th he passes through inferior conjunction, and becomes technically an evening star, though he will not be visible again until next month.

Venus is an evening star in Aries and is becoming more and more prominent. By the end of the month she sets at 8:30 P. M., and is a very conspicuous object.

Mars is in Ophiuchus—which though not one of the zodiacal constellations is traversed by the ecliptic. He is moving slowly eastward among the stars, approaching the earth and growing brighter; and he surpasses all the stars except Sirius. He rises just before midnight at the beginning of the month, and at 10:25 P. M. at its close. With the telescope he shows a disk of diameter increasing from ten to fourteen seconds during the month, and strongly gibbous, like the moon three days from the full.

Jupiter is in opposition on the 4th, and is splendidly visible all night long. He is in Virgo, north and west of Spica, and cannot be mistaken, as he is brighter than Sirius and far exceeds anything else in sight.

Saturn is also in Virgo, eight or ten degrees west of Jupiter, and, like him, is visible practically all night.

Uranus is a morning star in Aquarius, too near the sun to observe conveniently, while Neptune is in Cancer, and comes to the meridian at 7:30 P. M. in the middle of the month.

The moon is in her first quarter at 1 A. M. on the 5th, full at 4 P. M. on the 11th, in her last quarter at 8 P. M. on the 18th, and new at midnight on the 26th. She is nearest the earth on the 10th, and farthest away on the 22nd. During the month she is in conjunction with Neptune on the 7th, Saturn on the 10th, Jupiter on the 11th, Mars on the 15th, Uranus on the 22nd, Mercury on the 27th, and Venus on the 28th.